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Compliance of 2012/13 Combat Ration Packs to the Recommended Nutritional Criteria

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ABSTRACT

DSTO has evaluated the nutrient content of 2012/13 Combat Ration One Man (CR1M), Patrol Ration One Man (PR1M) and Combat Ration Five Man (CR5M) against the Recommended Nutritional Criteria (RNC) for Combat Ration Packs (CRP). RNC ensure that soldiers are provided with their daily nutrient requirements when rationed on CRP. The evaluation was based primarily on analytical testing of samples of CRP components. The macronutrient and energy requirements generally met requirements. Compliance with the RNC for vitamins and minerals was better for CR1M and CR5M than for PR1M. The positive results for the 2012/13 CR1M in comparison to the 2008/09 CR1M, indicates that efforts to improve CRP have been effective.

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Compliance of 2012/13 Combat Ration Packs to the Recommended Nutritional Criteria

Executive Summary

The Defence Materiel Organisation (DMO) requested an evaluation of the 2012/13 menus of Combat Ration One Man (CR1M), Patrol Ration One Man (PR1M) and Combat Ration Five Man (CR5M) against the recommended nutritional criteria (RNC) and the military recommended dietary intakes (MRDI). This report details the results of the RNC evaluation only; the evaluation against the MRDI will be conducted in 2015/16 upon completion of storage trials.

The RNC were grouped as follows for the evaluation:

- **Macronutrients and Energy** (protein, total fat, saturated fat, trans fat, carbohydrate (CHO), energy and recommended percentage contribution of protein, fat and CHO to total energy (P:F:C))
- **Vitamins** (vitamins A, C, E, B₁, B₂, B₃, B₆, B₁₂, folate and K₁)
- **Minerals** (calcium, chromium, copper, iodine, iron magnesium, manganese, phosphorus, potassium, selenium, sodium and zinc).

The evaluation was based primarily on analytical testing of samples of combat ration pack (CRP) components from the 2000/01, 2008/09, 2009/10, 2010/11, 2011/12 and 2012/13 CRP. Where analytical data were not available, other sources, such as product information forms, were used.

Conclusions

The 2012/13 CRP menus generally met the RNC requirements for macronutrients and energy with the following being of note:

- The RNC for energy (16 MJ) was met by all CRP menus (range 17.5 to 19.7 MJ). Consideration may need to be given to the costs and benefits of such a generous margin
- CR1M and CR5M only marginally met the protein requirement, whereas PR1M exceeded requirements
- On average, all three types of CRP were within the desired range for total fat, albeit marginally high for CR1M
- All CRP menus had levels of saturated and trans fats (combined) above the recommended maximum value

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- CHO was consistently high and well distributed across all CR1M, PR1M and CR5M menus
- The P:F:C of 13-18:23-33:54-59 was not met by any of the three types of CRP. PR1M performed best on this measure – the ratio was within range for protein and fat, and only marginally above the recommended level for CHO.

Owing to some fortification, compliance with the RNC for vitamins was better for CR1M and CR5M than for PR1M:

- The fortified CR1M and CR5M menus met the RNC for seven of the ten vitamins
- The unfortified PR1M met the RNC for only three of the ten vitamins. The lack of fortification of main meals is the key factor in the failure of PR1M to fully meet vitamin requirements.

All three types of CRP were non-compliant with respect to the RNC for minerals:

- CR1M was compliant with most RNC, a notable failure being the high levels of sodium
- CR5M was non-compliant for calcium, sodium, manganese and selenium
- The least compliant type of CRP was PR1M, with non-compliances for calcium, iodine, iron, magnesium, potassium and zinc
- Inclusion of calcium fortified chewing gum in approximately half the menus has resulted in CR1M, on average, meeting the RNC for calcium and significant improvement in the overall calcium status of CR5M and PR1M.

The nutrient profile of CR1M has improved relative to the 2008/09 procurement. Particular improvements were noted for protein, vitamin A, calcium and iron. The vitamin B₆, folate and vitamin K levels remain low and need to be improved. Vitamin E levels in CR1M and CR5M will fail to meet the RNC if the chocolate spread is removed and not replaced with an equivalent product.

PR1M failed to meet more requirements than CR1M and CR5M largely due to there being no fortification of its components. PR1M is used by Special Forces soldiers, yet does not comply with vitamin and mineral RNCs. This is of particular concern as Special Forces soldiers 'push the envelope' with respect to physical activity levels and endurance. For good cognitive and physical performance appropriate levels of nutrition, and particularly vitamins and minerals, are needed.

Common items contribute half the energy content of CR1M and PR1M and considerably more in the case of CR5M. The commonality, or repetition, of menu items should be as low as practicable to avoid menu boredom and to encourage consumption.

Recommendations

It is recommended that:

- DMO's continual improvement process for CRP remains in place as it has achieved demonstrable benefits

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- A focus is placed on improving the PRIM through fortification with selected vitamins and essential minerals
- Chewing gum fortified with calcium is included in all CRP menus
- The level of commonality in CRP menus is reviewed with a view to reducing the likelihood of menu fatigue and under-consumption.

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Acronyms

ADF	Australian Defence Force
BDL	below detection limit
CHO	carbohydrate
CR1M	Combat Ration One Man
CR5M	Combat Ration Five Man
CRP	combat ration pack
DMO	Defence Material Organisation
DSTO	Defence Science and Technology Organisation
FAO	Food and Agriculture Organisation
FD	freeze dried
FSANZ	Food Standards Australia New Zealand
LL	lower limit
MRDI	military recommended dietary intake
NHMRC	National Health and Medical Research Council
P:F:C	protein:fat:carbohydrate ratio
PIF	Product Information Form
PR1M	Patrol Ration One Man
RNC	recommended nutritional criteria
RPP	ration packing program
UL	upper limit

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1. Introduction

1.1 Background

The Defence Materiel Organisation (DMO) has been engaged in a program of combat ration pack (CRP) improvement to ensure nutritional requirements are met. Probert and Bui (2013) evaluated Combat Ration One Man (CR1M) menus from the 2008/09 ration packing program (RPP) and reported that some recommended nutritional criteria (RNC) and military recommended dietary intakes (MRDI) requirements were not met. Subsequently, DMO requested¹ an evaluation of the 2012/13 menus of CR1M, Patrol Ration One Man (PR1M) and Combat Ration Five Man (CR5M) against the RNC and the MRDI (Forbes-Ewan, 2009).

This report details the results of an evaluation against the RNC (Appendix A) and the recommended contributions of protein, fat and carbohydrate to total energy – the P:F:C ratio. An evaluation of compliance with the MRDI will be undertaken in 2015/16 upon completion of storage trials.

2. Methods

2.1 Data Collection

This evaluation was based primarily on analytical testing of component samples rather than relying on product information supplied by the manufacturers. It was neither necessary nor practical to sample the entire suite of components packed in the 2012/13 menus of CR1M, PR1M and CR5M. Many components remain unchanged from year to year, therefore data on them could be sourced from previous analyses.² In those cases where such analytical data were not available, other sources, such as product information forms (PIFs), were used. Data were either non-existent or insufficient to enable evaluation against the RNC for the following nutrients: dietary fibre, pantothenic acid, biotin, choline, vitamin D and molybdenum.

Assumptions, decisions and protocols pertaining to data handling and preparation were:

- In-house analysis was performed for CRP built in 2000/01; external analyses were performed for CRP built from 2008 onward; potentially there could be issues arising from this change in approach as well as some variations across laboratories
- In-house analytical data from the 2000/01 CR1M nutritional analysis program was used for sugar, salt and curry powder
- Nutrient data was calculated based on the quantity and weight per item. The individual nutrient data presented here is represented for an average of two analyses; where each analysis was conducted on a minimum composite of 10

¹ S&T Support Request No. CRF 39/2013.

² In-house data and internal reports.

packets/pouches of the component being analysed. Therefore, the variation should be relatively small and packet-to-packet variation should not be an issue

- The nutrient content of each menu was calculated as the sum of the nutrient contributions of each component based on its quantity, weight and nutrient concentration. The following was noted:
 - The weights used were those reported on menu sheets (Appendix B)
 - Where the nutrient values were reported in duplicate, if both results were below the detection limit (BDL), a value of zero was used
 - Where duplicate analysis returned one numerical value and one BDL value, this has been quantified as the average of the numerical value and half the BDL value (Gochfeld, et al., 2006).
- Energy was calculated using the following factors: protein 17 kJ/g, fat 37 kJ/g, carbohydrate (CHO) 17 kJ/g, dietary fibre (when available) 8 kJ/g
- CHO (%) was calculated as $[100 - (\text{protein} + \text{fat} + \text{ash} + \text{moisture} + \text{dietary fibre})]$, noting that dietary fibre values were available for only a small number of components
- PIF or Foodworks³ data was used for the following items:
 - Black pepper (no data for vitamins or minerals)
 - Freeze dried (FD) savoury beef (incomplete data for vitamins and minerals)
 - FD beef and black bean sauce (incomplete data for vitamins and minerals)
 - FD veal italienne (incomplete data for vitamins and minerals)
 - FD beef and green beans (incomplete data for vitamins and minerals).

In the absence of complete vitamin and mineral data for the four FD meals above, it was assumed that the levels were equal to the mean of four other meals for which data was available

- Protein and fat results for the beverage powders (orange, grape and lemon and lime) were not available. Zero values for these nutrients in these products were assumed
- Analytical results for beef vindaloo were also used for lamb vindaloo
- Chewing gum containing calcium phosphate was assumed to have the same concentration of calcium as the chewing gum used in the 2011/12 menu
- Nutrients contained in the flavour sachet for noodles were included in calculations, assuming a net weight of 3 g. This was in addition to the 40 g content for noodles.

2.2 Evaluation

The nutrient content for each of the three types of CRP: CR1M (eight menus, designated A to H); PRIM (five menus, A to E); and CR5M (five menus, A to E), were summarised and assessed against the RNC for general purpose CRP for male Australian Defence Force

³ FoodWorks 7, Professional Edition, 2012, Xyris Software (Australia) Pty Ltd

(ADF) members working at ADF physical activity level 3 (category 3) (Forbes-Ewan, 2009). The RNC (Table A1 at Appendix A) provides the RNC for CRP at the time of consolidation, or packing. It includes an allowance for degradation of certain nutrients during the period between packing and consumption.

The detailed compositions of CR1M, PR1M and CR5M are provided in the attached menu sheets (Appendix B). Summaries presented in Tables C1 and C2 provide a ready means of comparison of the component types and groups (Appendix C).

The evaluation was performed on 27 of the 33 RNC for which nutrient data was available. Insufficient data was available for vitamin D, dietary fibre, pantothenic acid, biotin, choline and molybdenum.

The RNC were grouped as follows for the evaluation:

- **Macronutrients and Energy** (protein, total fat, saturated fat, trans fat, CHO, energy content and recommended percentage contribution of protein, fat and CHO to total energy (P:F:C).
- **Vitamins** (vitamins A, C, E, B₁, B₂, B₃, B₆, B₁₂, folate and K₁).
- **Minerals** (calcium, chromium, copper, iodine, iron magnesium, manganese, phosphorus, potassium, selenium, sodium and zinc).

The RNC were based on the energy requirement for category 3 activity (16 MJ per day); there were no specified criteria for CRP for higher or lower levels of activity. The evaluation of nutrient levels is based on three categories:

1. Pass: requirement is met with a margin of at least 5%
2. Marginal: result is $\pm 5\%$ of the requirement
3. Fail: result is 5% or more outside the requirement.

Forbes-Ewan (2009) noted that 'the contributions made by the macronutrients protein, fat and carbohydrate to total energy intake is believed to have major influences on both physical work capacity and long-term health outcomes'. The RNC for protein, total fat, CHO and sodium have been expressed as ranges with a lower limit (LL) representing the recommended minimum level and an upper limit (UL) for the recommended maximum level.

Recommended P:F:C values were provided for five categories of daily energy expenditure; the P:F:C values for category 3 (16 MJ/day) are used in this evaluation. Note that the average energy value of CRP built in 2012/13 was 19 MJ, however as typical energy expenditure is more likely to be 16 MJ consistency in approach was maintained through the use of category 3 P:F:C: values.

3. Results and Discussion

3.1 Macronutrients and Energy

The macronutrient and energy results are summarised in Table 1.

Table 1 *Macronutrients and energy content vs RNC*

	Nutrient	Protein	Fat - total	Fat - sat + trans	CHO	Energy
CR1M	RNC	122-150 g	108-143 g	≤43	565-590 g	16 MJ
	A	135	147	77	667	19.3
	B	138	138	76	636	18.0
	C	108	151	83	667	19.0
	D	119	135	69	643	18.2
	E	114	157	80	685	19.7
	F	132	148	76	673	19.4
	G	124	134	74	637	18.1
	H	112	136	72	660	19.4
	MEAN	123	143	76	659	18.9
PR1M	A	137	110	62	640	17.5
	B	154	129	62	653	18.7
	C	173	129	58	664	19.2
	D	118	125	67	658	18.1
	E	159	144	63	669	19.7
		MEAN	148	127	62	657
CR5M	A	116	136	75	652	18.3
	B	134	125	66	638	17.5
	C	111	135	70	667	18.4
	D	102	124	68	654	17.6
	E	125	129	70	671	18.5
		MEAN	118	130	70	656

Legend to colour coding

	Pass. Requirement is met with a margin of at least 5%.
	Marginal. Result is within 5% of the requirement.
	Fail. Result is 5% or more outside the requirement.

3.1.1 Protein

On average, CR1M and CR5M only marginally met the protein requirement, whereas PR1M approached the UL. The protein content of each CR1M, PR1M and CR5M menu has been charted for comparison with the RNC range (Figure 1). Protein was well distributed across all menus, although not all menus fully met the requirements.

The major protein contributors in CR1M were the retort pouch main meals and tuna. Two of the main meals –sausages & vegetables and curried sausages & vegetables –were low in protein and would need to be paired with one of the highest protein main meals in order for the LL to be met. Other good contributors of protein were muesli mix, processed cheese, sweetened condensed milk, beef steak bar and cereal bars.

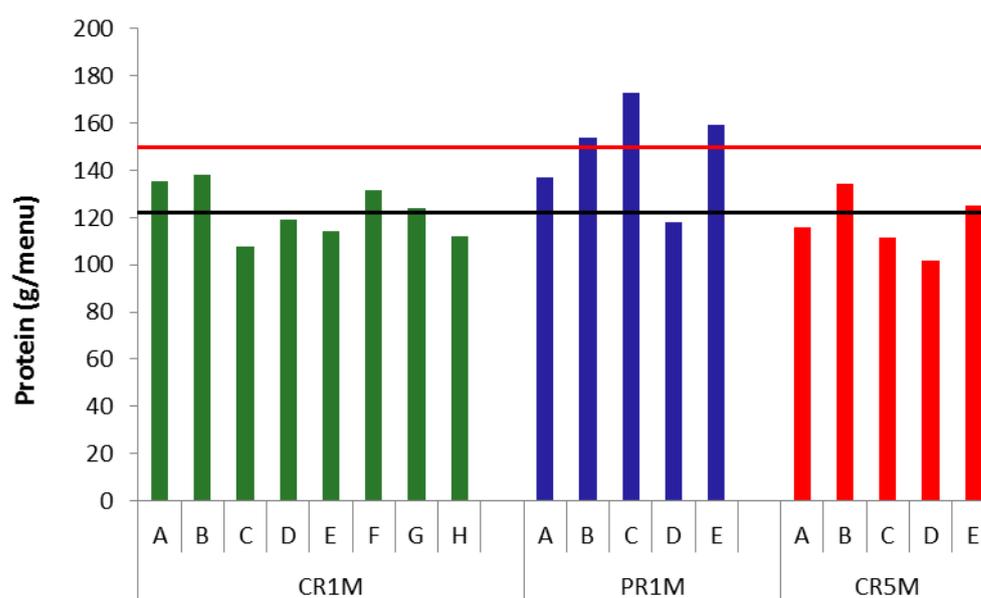


Figure 1 Protein content of 2012/13 CRP. The red line indicates the UL and the black line the LL of the RNC

There has been a substantial improvement in protein levels in CR1M menus compared to the 2008/09 RPP in which only menu A met the LL (Probert and Bui, 2013). Since 2008/09, the protein content of CR1M has been enhanced by the inclusion of muesli mix and beef steak bar.

In PR1M, the main contributor to protein content was the main meal component –two FD meals per menu –providing 61–106% of the LL. Menu D contained the FD meals with the lowest protein contents, leading to the lowest total protein content at 97% of the LL. Menus B and E exceeded the UL by ~3% and 6% respectively, whereas menu C exceeded the UL by 15%.

High contributors of protein in CR5M are the main meals, baked beans and beef steak bar. CR5M is the only CRP for which more than 50% of the protein was provided by the common items.

3.1.2 Fat

As indicated in Table 1, on average, all three types of CRP were within the desired range for total fat, albeit marginally high for CR1M. At the individual menu level, the LL was achieved by all CRP menus (Figure 2). CR1M menus A, C, E and F exceeded the UL marginally, i.e. not more than 10% above the UL, and PR1M menu E is at the UL.

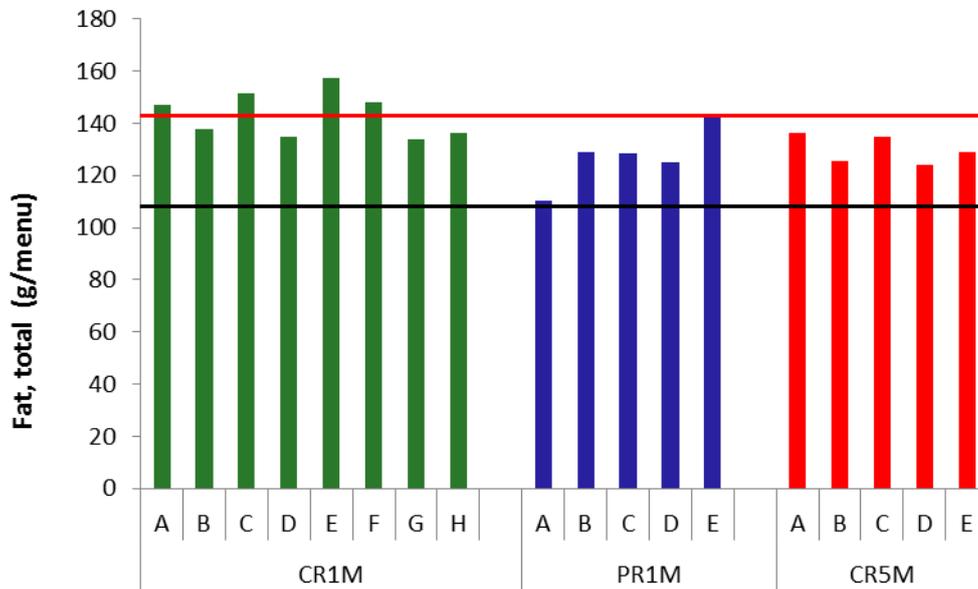


Figure 2 Total fat content of 2012/13 CRP. The red line indicates the UL and the black line the LL of the RNC

Components with high total fat content were the main meals (both retort pouches and FD meals), chocolate products (ration chocolate, chocolate candy, chocolate spread) and processed cheese.

Most of the main meals provided more than 10% of the LL for total fat, except 3 items: chicken pasta with vegetables (~5%), barbeque chicken (7%) and chicken italiano (~2%) in menus B, D and G respectively. Despite the low fat content of these items, none of these menus failed to meet the LL for total fat.

3.1.3 Saturated fat plus trans fat

The RNC for saturated and trans fat combined (sat+trans fat) was ≤ 43 g. This was exceeded by all CRP menus with the excess ranging from 19-40 g per menu (Table 1 and Figure 3).

Sat+trans fat are naturally present in some animal foods, such as beef and lamb, and is especially high in ready-to-eat and processed foods, including biscuits, soups, processed cheese, ration chocolate and chocolate candy (Dietitians Association of Australia, 2014; Defence Science and Technology Organisation (DSTO), unpublished data). Therefore, controlling the sat+trans fat levels in CRP is a challenge due to the processed nature of the components.

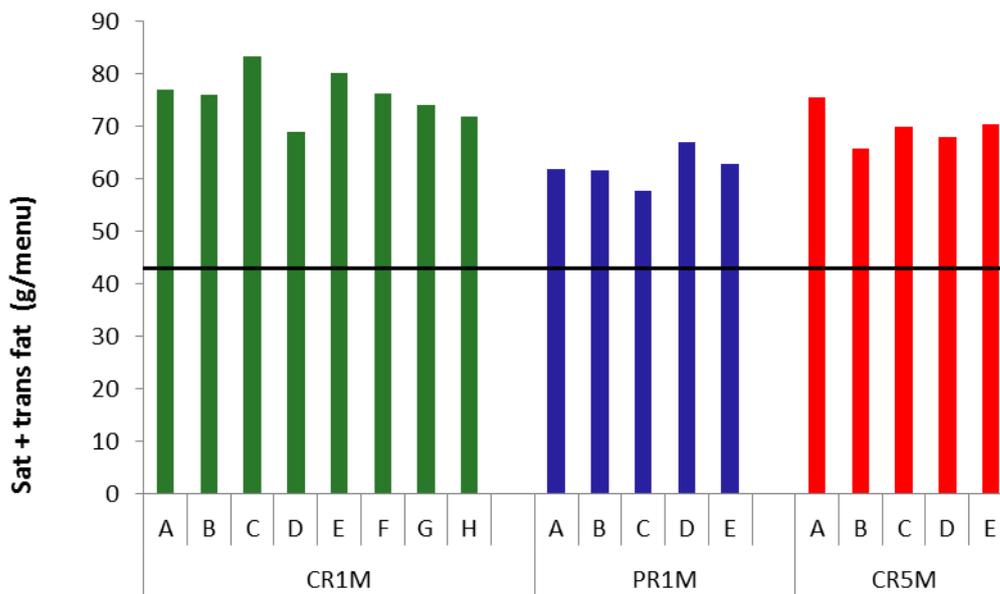


Figure 3 Saturated plus trans fat content of 2012/13 CRP vs RNC

3.1.4 Carbohydrate

Figure 4 indicates CHO was consistently high and well distributed across all CR1M, PR1M and CR5M menus. CHO in CRP exceeded the UL by 8-16%, increasing the total energy content of CRP and disrupting the recommended P:F:C. Major contributors were the beverage powder, ration chocolate and sweetened condensed milk, providing 12%, 11% and 9% of the LL respectively.

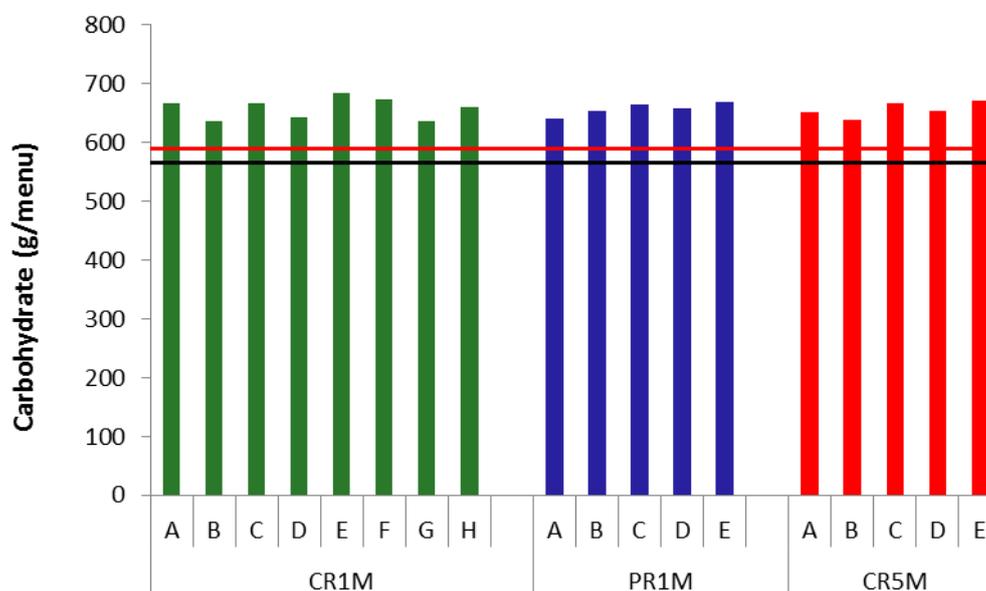


Figure 4 CHO content of 2012/13 CRP. The red line indicates the UL and the black line the LL of the RNC

When the RNC is next revised, the energy value for CHO will change from 16 kJ/g, which was used in the current version, to 17 kJ/g, which is the value in general use today (Food and Agriculture Organisation, undated)⁴. Consequently, the RNC range for CHO will decrease to 508-555 g per menu (Pers. Comm. Forbes-Ewan, 25 June 2014). If the CHO content of CRP remains the same as in 2012/13, then the excess will be proportionately greater when the RNC range changes.

⁴Analysts round this value to 17 for calculating energy from CHO.

3.1.5 Energy

The RNC for energy was exceeded by all CRP menus. The energy content ranged from 17.5 to 19.7 MJ, significantly above the RNC (Figure 5). The major contributors—the components that provided more than 10% of the RNC—were FD meals (25-36%), retort pouch main meals (13-18%), ration chocolate (14%), muesli mix (10–11%) and cereal bars (9.5-10.5%). High sugar components such as beverages, chocolate candy, sweetened condensed milk and chocolate spread contributed around 7–8% of the total energy.

There were three retort meals (chicken italiano, chicken pasta with vegetables, and sausages & vegetables) that contributed less than 5% of the RNC (3.7, 3.1 and 4.7% respectively).

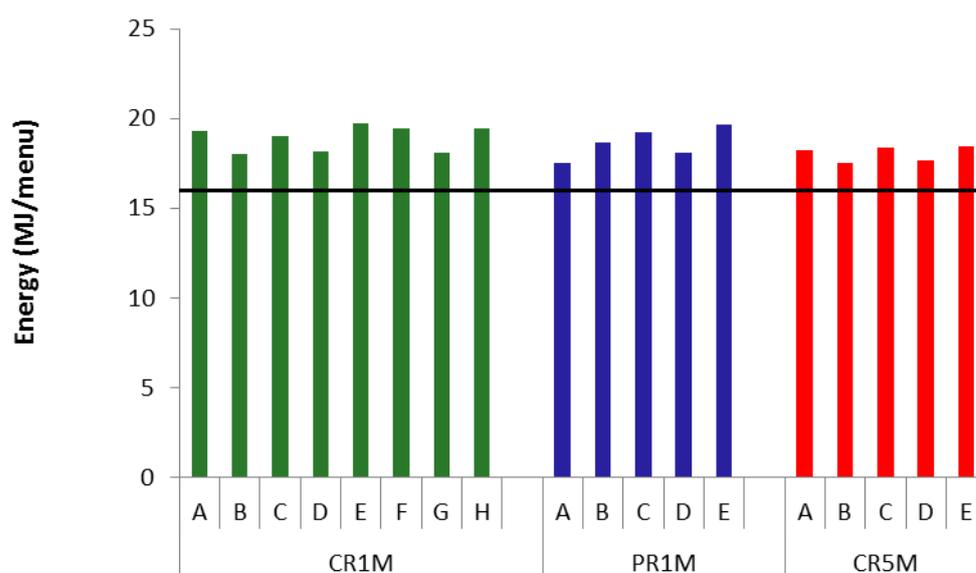


Figure 5 Energy content of 2012/13 CRP vs RNC

Common items, i.e. those items common to all menus of a CRP type, provided 52%, 49% and 70% of the RNC for energy for CR1M, PR1M and CR5M respectively. The proportion of energy provided by common items should be as low as practicable to avoid menu boredom and under-consumption. Certainly, CR5M menus were a problem as a very high proportion of their energy content came from a few common items.

There would be cause for concern about the nutritional adequacy of CRP if the energy content was substantially lower than 16 MJ, as it was in the 1980s and 1990s (James, et al.

1993; internal report⁵). As the 2012/13 CRP menus provided substantially more energy than the RNC the following questions may be asked:

- Does the increased energy content alter the quantity and types of items discarded by soldiers, and if so, how?
- Have consumption rates changed, i.e. does the soldier eat more?
- What is the cost-benefit of providing more energy in CRP?
- Why is the energy content substantially above the RNC?

While the scope of this report did not include exploring answers to these questions; they are presented here to initiate discussion of the factors that may have led to higher energy content in CRP and whether continued higher energy levels are desirable.

3.1.6 Protein:Fat:Carbohydrate Ratio

The P:F:C of 13-18:23-33:54-59 was not met by any of the three types of CRP (Table 2). The ratio for PR1M was, however, close to being within range for protein and fat, and only marginally above the recommended level for CHO. The energy contribution by protein was below the recommended level for CR1M and CR5M, although the actual protein content was only marginally low. The percentage contribution by protein to total energy would have been higher, but the excessive amount of CHO present in all three types of CRP reduced the proportional contribution by protein.

Table 2 P:F:Cs for 2012/13 CRP

Contribution to total energy by:	Protein	Fat	CHO
Recommended range	13-18%	23-33%	54-59%
CR1M	11.2	28.5	60.2
PR1M	13.7	25.6	60.8
CR5M	11.1	26.7	62.1

Legend to colour coding

	Pass. Requirement is met with a margin of at least 5%.
	Marginal. Result is within 5% of the requirement.
	Fail. Result is 5% or more outside the requirement.

⁵ Walker, G.J., Nanayakkara, A., Forbes-Ewan, C., Thomson, G. and Driver, G. 1996. Laboratory evaluation of Australian one man ration packs, 1994-95 procurement. Internal report.

3.2 Vitamins

3.2.1 Overview

The compliance of all CRP menus with the RNC for vitamins is summarised in Table 3. All CR1M and CR5M menus were fortified with vitamins A, C, B₁, B₂ and B₃. The benefits of fortification have been demonstrated in the results. All three types of CRP continue, however, to have insufficient levels of vitamin B₆ and K. CR1M and PR1M failed to meet the RNC for folate, whereas CR5M gained approximately 250 µg folate from the vegetable components and did meet the requirement.

Overall, PR1M performed poorly, meeting the RNC for only three of the ten vitamins. A lack of fortification is a key factor in the failure of PR1M to fully meet vitamin requirements.

3.2.2 Vitamin A

The vitamin A content across the range of CRP menus was approximately double the RNC (Figure 6). The main contributor was ration chocolate, which on average provided 90% of the vitamin A in CR1M, PR1M and CR5M. Other sources included processed cheese (90 µg), sweetened condensed milk (57 µg), FD tuna mornay (102 µg) and FD savoury beef (94 µg). Vitamin A is toxic when consumed in excess, but none of the CRP menus provided quantities approaching the UL of 3000 µg/day (NHMRC 2006).

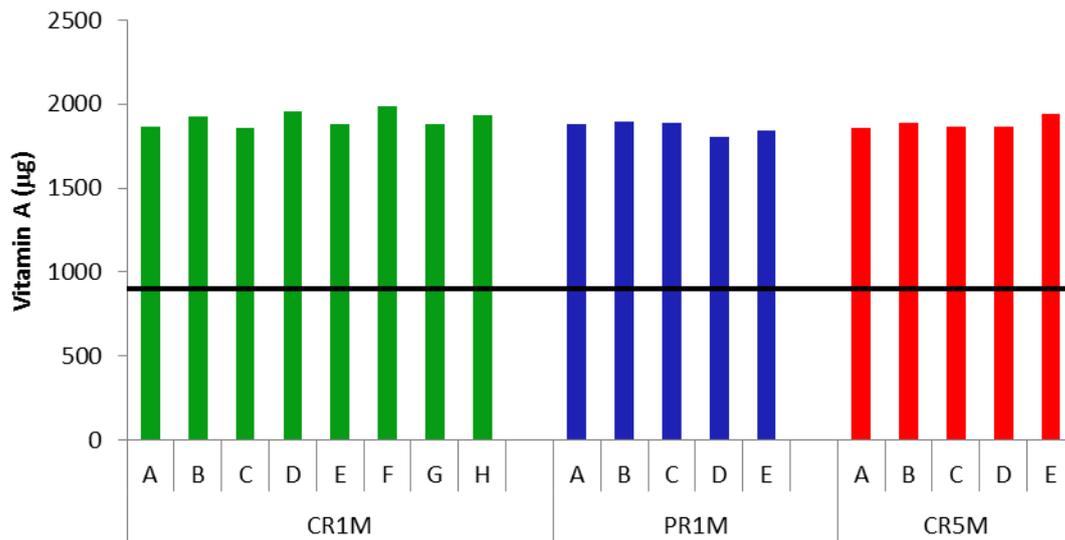


Figure 6 Vitamin A content of 2012/13 CRP vs RNC

The intake of sufficient vitamin A is reliant upon consumption of at least one block of ration chocolate. In the unlikely event of all the ration chocolate being discarded the remainder of the ration pack would provide only 25% (approximately) of the RNC.

Table 3 Summary of CRP vitamin content versus the RNC

	Vitamin	A	C	E	B ₁	B ₂	B ₃ Equiv.	B ₆	B ₁₂	Folate	K
	RNC	900 µg	135 mg	10 mg	5.1 mg	7.5 mg	78 mg	7.5 mg	2.4 µg	400 µg	70 µg
CR1M	A	1865	799	14	7.3	8.7	115	0.4	7.5	358	45
	B	1924	815	15	7.1	7.8	100	0.5	5.3	162	29
	C	1859	778	14	7.7	8.6	87	0.2	2.8	200	33
	D	1955	871	15	7.7	8.4	111	0.5	4.1	158	42
	E	1883	761	13	7.9	8.3	90	0.3	3.5	244	49
	F	1986	592	21	7.2	6.4	113	0.3	6.7	274	24
	G	1884	699	15	7.6	8.2	89	0.1	4.9	397	30
	H	1930	769	15	7.8	8.3	95	0.4	6.7	375	49
	MEAN	1911	760	15	7.5	8.1	100	0.3	5.2	271	38
PR1M	A	1877	299	5.8	4.9	3.2	65	0.4	6.7	127	36
	B	1896	291	4.6	5.0	3.1	45	0.5	7.2	64	33
	C	1888	296	6.8	4.9	3.2	34	0.4	7.2	114	41
	D	1803	338	8.1	5.1	3.2	52	0.3	6.0	212	65
	E	1840	318	8.2	4.9	3.3	34	0.4	7.3	143	42
		MEAN	1861	308	6.7	5.0	3.2	46	0.4	6.9	132
CR5M	A	1859	947	16	8.1	7.5	108	0.4	3.5	353	44
	B	1886	869	20	8.0	7.2	108	0.5	4.6	433	35
	C	1865	890	16	8.5	7.3	101	0.3	2.8	444	49
	D	1866	893	16	8.2	6.9	98	0.4	2.5	530	43
	E	1940	797	18	8.1	5.5	103	0.3	4.4	523	30
		MEAN	1883	879	17	8.2	6.9	104	0.4	3.6	457

Legend to colour coding

	Pass. Requirement is met with a margin of at least 5%.
	Marginal. Result is within 5% of the requirement.
	Fail. Result is 5% or more outside the requirement.

3.2.3 Vitamin C

All CRP menus met the RNC for vitamin C (Figure 7). The vitamin C content of CR1M, PR1M and CR5M menus were approximately 5, 2 and 6 times the RNC respectively. The main contributors were fortified main meals (flexible retort pouches), ration chocolate and beverage powders – each providing approximately 100-400 mg vitamin C – with several other components making relatively small contributions.

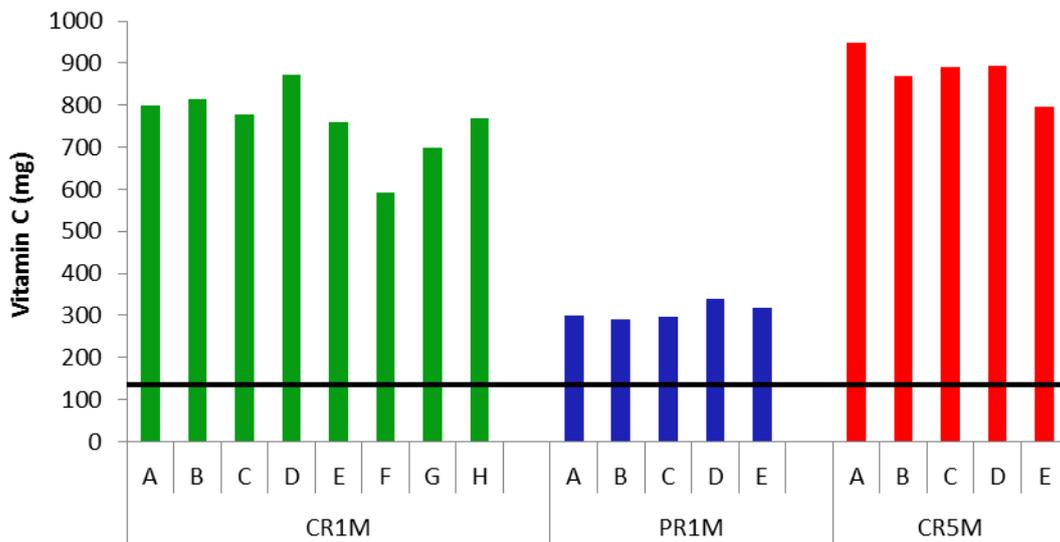


Figure 7 Vitamin C content of 2012/13 CRP vs RNC

The retort pouch main meal items in CR1M and CR5M are expected to lose 60-90% of their vitamin C during storage (Probert and Bui, 2013). Vitamin C is stable in beverage powder. The inclusion of these powdered beverage mixes ensures all CRP menus retain adequate amounts of vitamin C during storage.

3.2.4 Vitamin E

All menus of CR1M and CR5M exceeded the RNC for vitamin E, however none of the PR1M menus achieved the required level (Figure 8). The chocolate spread was the main contributor, without it only one CR1M menu and two CR5M menus would meet the RNC for vitamin E. If it was added to PR1M all menus would meet the RNC. Reliance upon this one component is of concern. Consideration should be given to reducing the dependence on a single ration item for delivering vitamin E by improving the levels and distribution across a range of CRP components. It is understood that removal of the chocolate spread is highly likely; if it is removed then the aforementioned potential failures to meet the RNC will be the consequence.

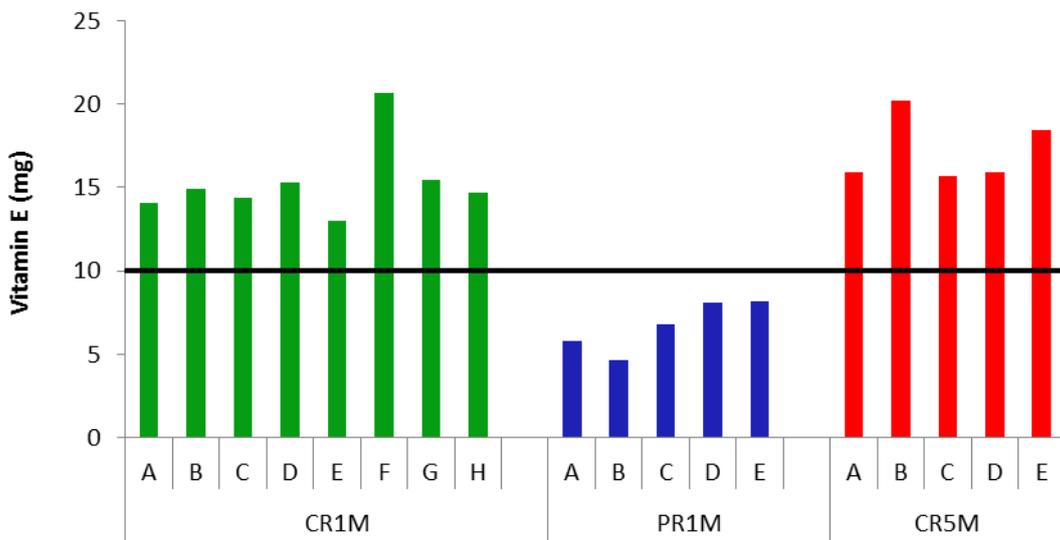


Figure 8 Vitamin E content of 2012/13 CRP vs RNC

3.2.5 Vitamin B₁ (thiamin)

The RNC for vitamin B₁ was met for all menus of CR1M and CR5M, but all the PR1M menus were marginal with respect to this vitamin (Figure 9). Similar to the situation with vitamin A, the required amount of vitamin B₁ (5 µg) was provided by concentrated yeast extract (2.2 µg), ration chocolate (2.1 µg) and fortified main meals in CR1M and CR5M (~2.5 µg), with some smaller, but important, contributions by cereal-based components.

The main difference between PR1M and the other two types of CRP was the use of fortified retort pouch meals in the latter, whereas the PR1M FD main meals are not fortified. Freeze dried meals could be fortified with vitamins to improve the nutrient profile of PR1M and to better distribute vitamins across the range of components (Bui and Coad, 2011).

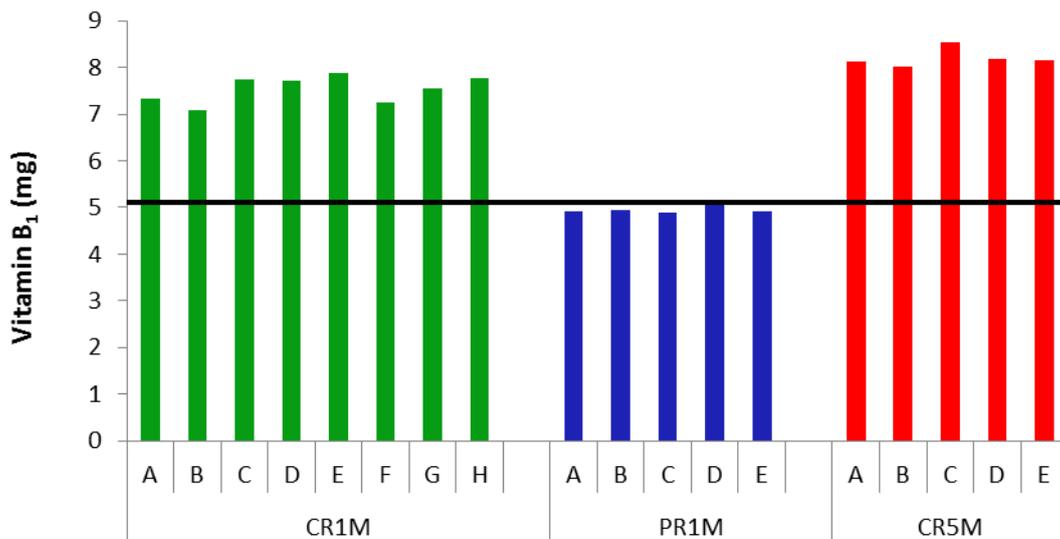


Figure 9 Thiamin content of 2012/13 CRP vs RNC

3.2.6 Vitamin B₂ (riboflavin)

CR1M met the RNC (7.5 mg) for vitamin B₂ with the exceptions of menu B, which was marginal, and menu F, which failed to reach the requirement (Figure 10). The main contributors were the main meals, each of which contributed approximately 2.5 mg vitamin B₂ – however one of the main meals in menu F contributed less than 0.5 mg hence the relatively poor performance of this menu. Concentrated yeast extract contributed 2.1 mg vitamin B₂ to each menu of CRP and, after main meals, was the next most important contributor for CR1M and CR5M and the most important contributor for PR1M. Three CR5M menus contained marginal amounts of vitamin B₂, whereas menus D and E failed to meet the requirement. Menu E failed by 27% - note that this menu contained the same under-performing main meal as CR1M menu F. All PR1M menus contained less than 45% of the RNC for vitamin B₂ and would contain only 15% of the RNC if the concentrated yeast extract was not included.

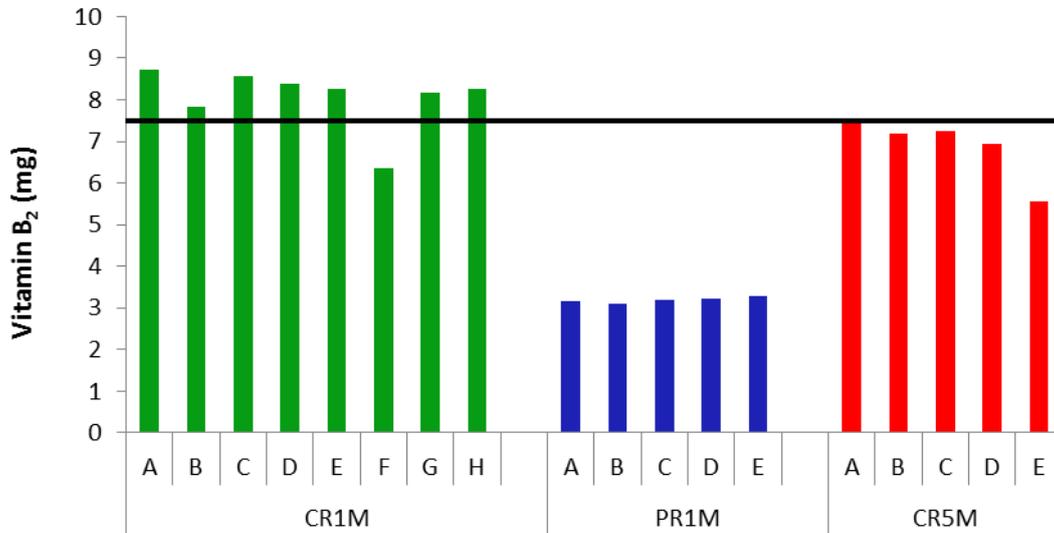


Figure 10 Riboflavin content of 2012/13 CRP vs RNC

3.2.7 Vitamin B₃ (niacin)

The niacin equivalent content of all CR1M and CR5M menus met the RNC, but the PR1M menus ranged between 44% and 83% of the RNC for this vitamin (Figure 11). The main CR1M contributors of niacin equivalents were main meals, concentrated yeast extract and, where included, tuna-based light meals. In the case of CR5M, the main meals, baked beans and concentrated yeast extract were the main sources, whereas for PR1M the contributions of main meals and concentrated yeast extract were comparable.

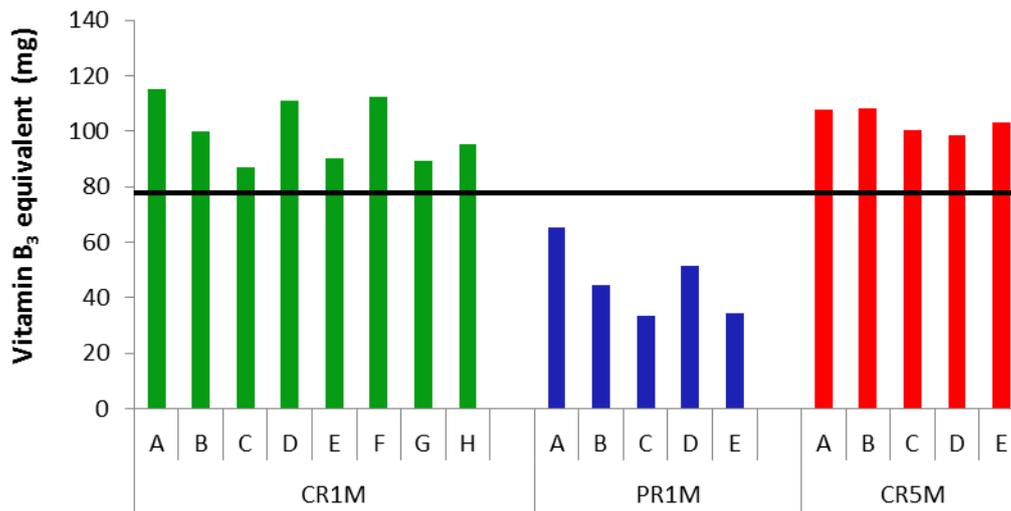


Figure 11 Vitamin B₃ (niacin) equivalent content of 2012/13 CRP vs RNC

3.2.8 Vitamin B₆

The vitamin B₆ content of CRP menus ranged from 0.1–0.5 mg, approximately 2–7% of the RNC (Figure 12). Vitamin B₆ was present at low levels in a few CRP components, including beef steak bar, concentrated yeast extract, ration chocolate, muesli mix, cereal bar, biscuits and some main meals. Other CRP components did not make significant contributions to the total vitamin B₆ content.

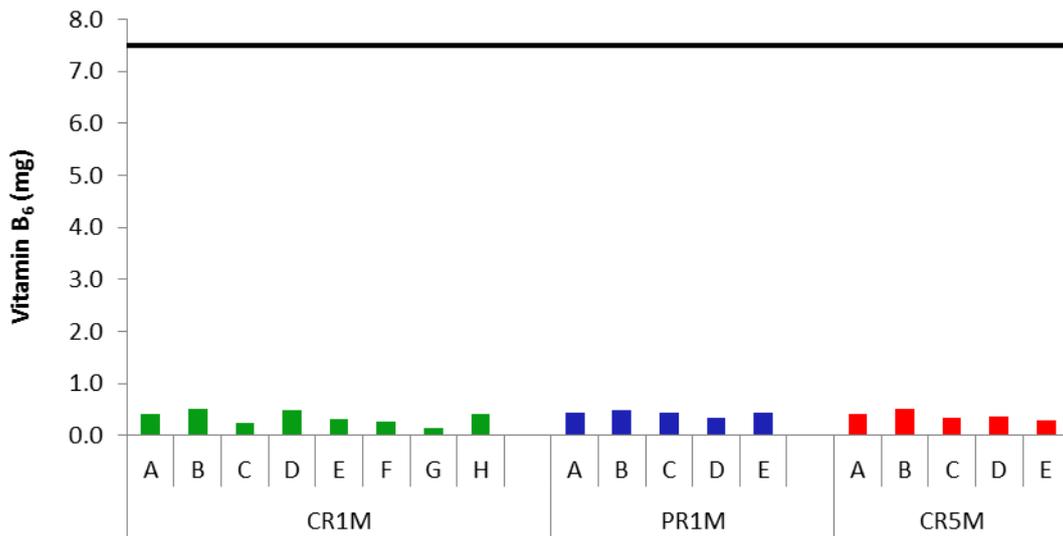


Figure 12 Vitamin B₆ content of 2012/13 CRP vs RNC

The RNC for vitamin B₆ has been set at three times the MRDI to allow for potential losses during the period between delivery to ADF and consumption by soldiers (Forbes-Ewan, 2009). The figures presented here indicate that even at the time of receipt by ADF the amount of vitamin B₆ was insufficient to meet the MRDI. Probert and Bui (2013) examined the 2008/09 procurement of CR1M and reported similar levels (0.3-0.8 mg/menu). Forbes-Ewan (2009) recommended that a wide variety of ration pack items be fortified with thiamine, vitamin C, riboflavin and vitamin B₆, but the option to fortify with vitamin B₆ has not been implemented and CRP remain deficient in this vitamin.

3.2.9 Vitamin B₁₂

The RNC for vitamin B₁₂ was met by all CRP menus (Figure 13). The main contributors were tuna-based light meals, main meals and processed cheese. On average, the PR1M exceeded the RNC by a greater margin than CR1M and CR5M due to the much higher meat content in FD main meals compared to retort pouch main meals. Processed cheese, not present in PR1M, and ration chocolate, common to all CRP menus, were also good sources of vitamin B₁₂.

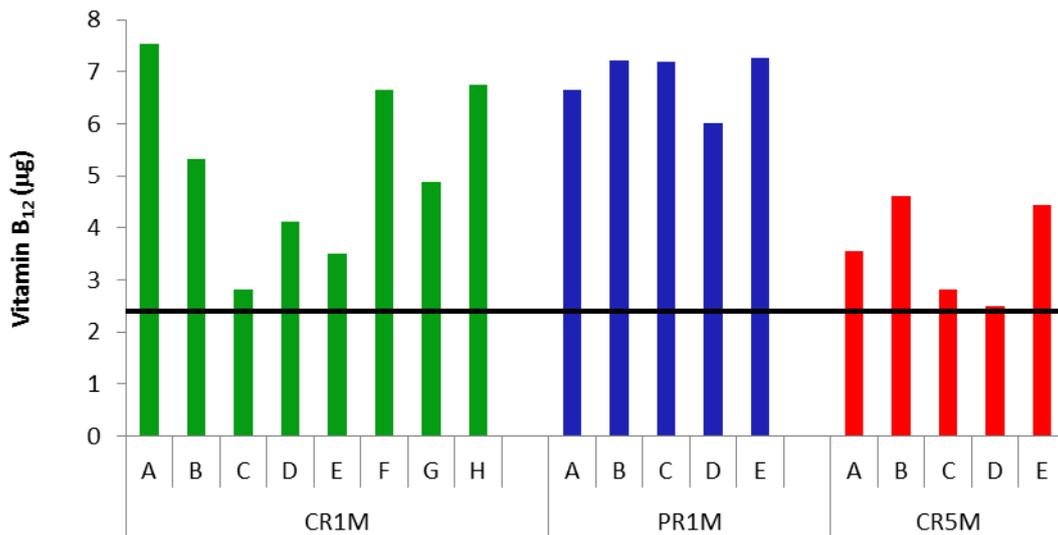


Figure 13 Vitamin B₁₂ content of 2012/13 CRP vs RNC

3.2.10 Folate

The CR1M and PR1M menus failed to meet the RNC of 400 μg folate, although menu G was marginal (Figure 14). Four of the five CR5M menus met the RNC. This key difference results from canned vegetables being included in the CR5M. The mean value for folate in CR1M was 271 μg and in PR1M it was 132 μg . Folate was well-distributed across the range of CRP menus with the main sources being main meals, fruit and cereal-based products. PR1M contained less fruit and cereal-based products than CR1M, hence the relatively low folate values.

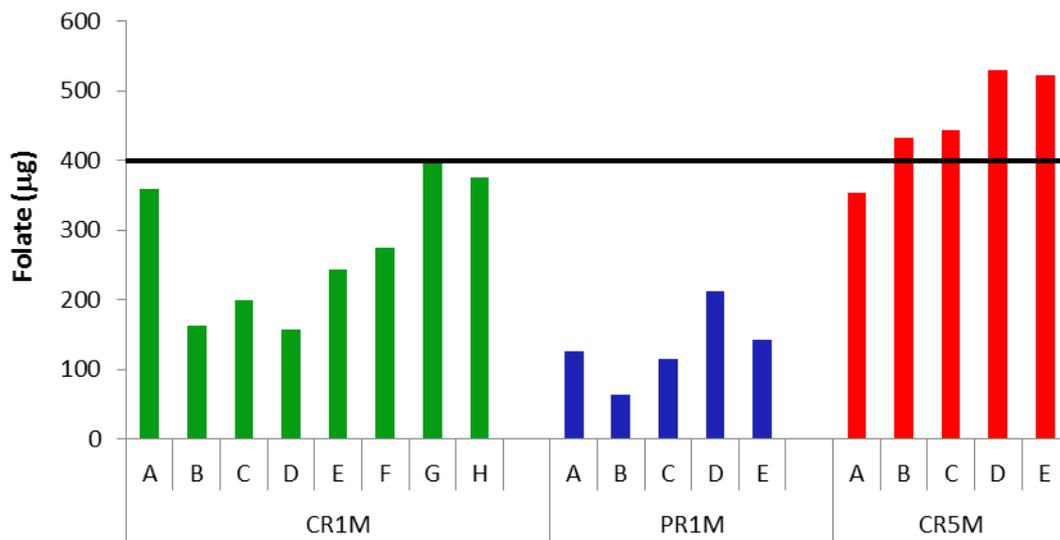


Figure 14 Folate content of 2012/13 CRP vs RNC

3.2.11 Vitamin K

None of the CRP menus met the RNC for vitamin K (Figure 15). The levels ranged from 34% (CR1M menu F) to 93% (PR1M menu D) of the RNC. The major dietary sources of vitamin K are green, leafy vegetables (NHMRC, 2006), therefore it is to be expected that CRP will be low in this vitamin compared to a fresh food diet. The best CRP sources were main meals, confectionery (high fat) and cereal-based products.

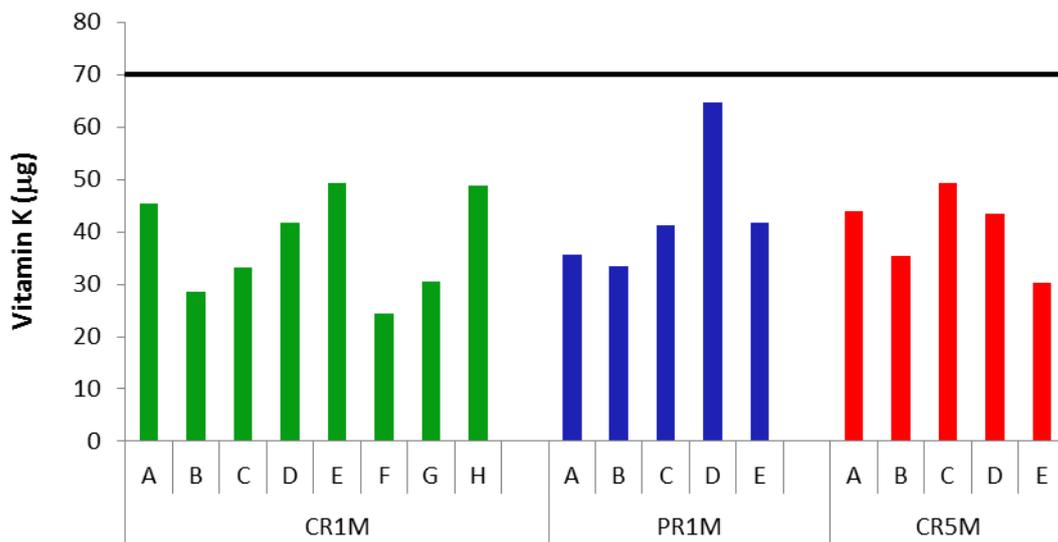


Figure 15 Vitamin K content of 2012/13 CRP vs RNC

3.3 Minerals

3.3.1 Overview

Table 4 summarises the performance of CRP against the RNC for minerals. All three types of CRP were non-compliant with the RNC for minerals. On the basis of the mean values across all menus, CR1M was close to being compliant except for its high levels of sodium. CR5M was non-compliant for calcium, sodium, manganese and selenium.

PR1M was non-compliant for calcium, iodine, iron, magnesium, potassium and zinc. Values for menus C and E of PR1M were consistently below those of other menus. The use of a database to calculate minerals content—see section 2.1—may have resulted in an underestimate. The use of analytical data when it becomes available may demonstrate compliance with the RNC.

Table 4 Summary of 2012/13 CRP mineral content versus the RNC.

Mineral	Ca	Cr	Cu	I	Fe	Mg	Mn	P	K	Se	Na	Zn	
RNC	1300 mg	35 µg	1.7 mg	150 µg	18 mg	410 mg	5.5 mg	1250 mg	3800 mg	70 µg	2300-4600 mg	14 mg	
CR1M	A	1204	81	1.8	225	20	452	7.1	2514	4375	112	5023	21.9
	B	1502	94	1.6	203	18	366	3.9	2065	3937	91	6123	20.5
	C	1197	92	1.9	235	20	448	7.0	2307	4031	51	6297	18.7
	D	1543	146	1.6	142	17	377	4.3	2093	3835	122	5425	14.5
	E	1812	89	1.8	327	20	442	7.2	2396	4374	54	6534	19.7
	F	1274	88	1.7	208	20	493	7.3	2512	4316	142	5924	19.9
	G	1648	149	1.7	167	18	369	4.2	2118	4100	72	6393	20.0
	H	1228	109	1.8	157	18	450	7.3	2346	4075	99	6344	14.2
	MEAN	1426	106	1.7	208	19	424	6.0	2294	4130	93	6008	18.7
PR1M	A	910	76	1.7	165	19	425	5.4	2221	4138	119	4867	19.2
	B	1194	69	1.9	123	16	327	5.3	1570	3303	54	4090	15.3
	C	618	50	1.9	95	10	264	5.5	1219	2490	65	2625	6.4
	D	1352	582	2.2	143	27	400	6.0	2061	4214	58	4594	18.0
	E	665	51	1.9	95	10	265	5.5	1293	2522	65	2746	6.5
	MEAN	948	165	1.9	124	16	336	5.5	1673	3333	72	3784	13.1
CR5M	A	1052	105	2.1	225	19	425	4.6	2131	4578	40	5915	19.8
	B	1315	112	2.0	189	20	426	4.7	2256	4505	81	6355	19.8
	C	1112	103	2.0	157	20	427	4.9	2115	4563	37	6583	18.6
	D	1361	168	2.0	265	19	420	4.7	2166	4447	38	6384	15.8
	E	1157	96	2.0	154	20	438	4.9	2218	4616	73	6453	19.1
	MEAN	1199	117	2.0	198	20	427	4.8	2178	4542	54	6338	18.6

Legend to colour coding

	Pass. Requirement is met with a margin of at least 5%.
	Marginal. Result is within 5% of the requirement.
	Fail. Result is 5% or more outside the requirement.

3.3.2 Calcium content in CRP vs RNC

CR1M exceeded the RNC of 1300 mg for calcium with a mean value of 1426 mg/100 g, however individual menus varied with three failing the requirement (Figure 16). Four PR1M menus were below the RNC, as were three CR5M menus. Calcium was well distributed across CRP menus with the most important sources being chewing gum, sweetened condensed milk, processed cheese, ration chocolate and muesli mix (with skim milk powder).

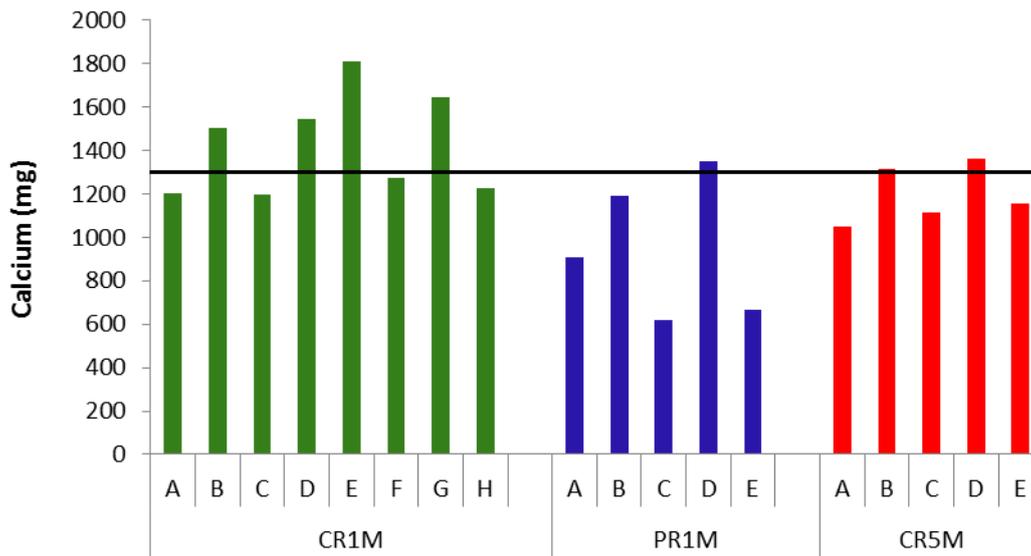


Figure 16 Calcium

Each CRP menu contained two packets of one of two flavours of chewing gum. One was fortified with calcium phosphate and the other was not fortified. If both were fortified with calcium to the level reported for the fortified flavour (47000 mg/kg) then all menus of CR1M would meet the RNC for calcium. Under that scenario, CR5M would on average meet the RNC and the average value for PR1M would nearly meet the RNC.

The calcium content of the 2012/13 CR1M is an improvement on the 2008/09 CR1M in which the calcium content ranged from 1050-1167 mg per menu. The inclusion of muesli mix with skim milk powder and chewing gum fortified with calcium have been the main reasons for the improvement. It is recommended that chewing gum fortified with calcium be included in all menus of CRP. Potentially, muesli mix with skim milk powder could also be added to more menus, subject to weight and energy constraints.

3.3.3 Chromium

The RNC for chromium was met by all menus of CRP (Figure 17). Menu D of PR1M contained more chromium than any other menu of CRP due to a high chromium value for FD spaghetti with meat sauce.⁶ No upper limit has been set for chromium (National Health and Medical Research Committee, 2006) with there being no significant health concerns through consumption of higher levels. Further testing will be conducted to determine whether this sample was typical or contaminated.

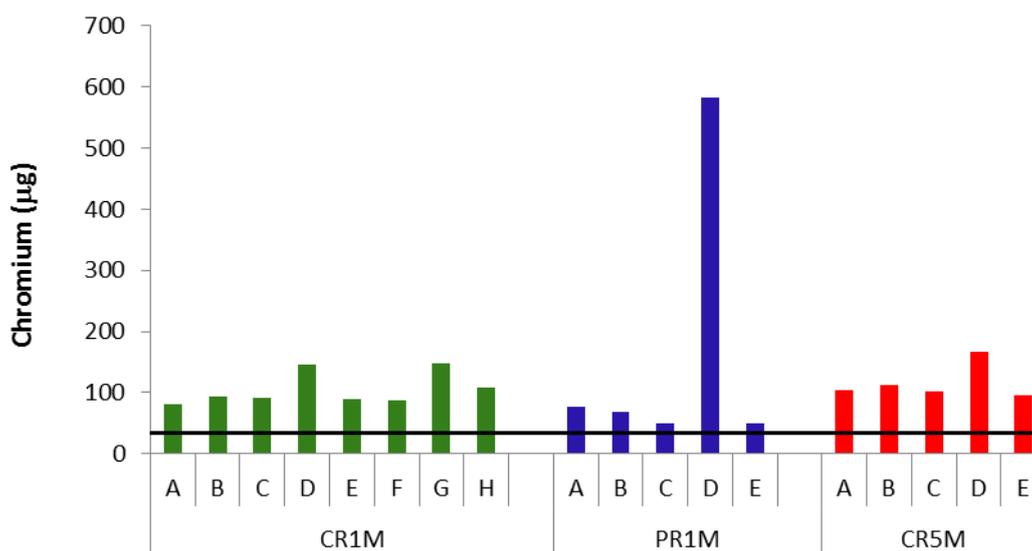


Figure 17 Chromium content of 2012/13 CRP vs RNC

⁶ The sample was reanalysed and the result was confirmed.

3.3.4 Copper

CR1M, on average, marginally met the RNC for copper (Figure 18). All menus of CR5M and four menus of PR1M met the RNC; one menu of PR1M was marginal. The main sources of copper were main meals, cereal-based products, chocolate-based products (chocolate drink powder, chocolate spread, chocolate candy, ration chocolate) and vegetables.

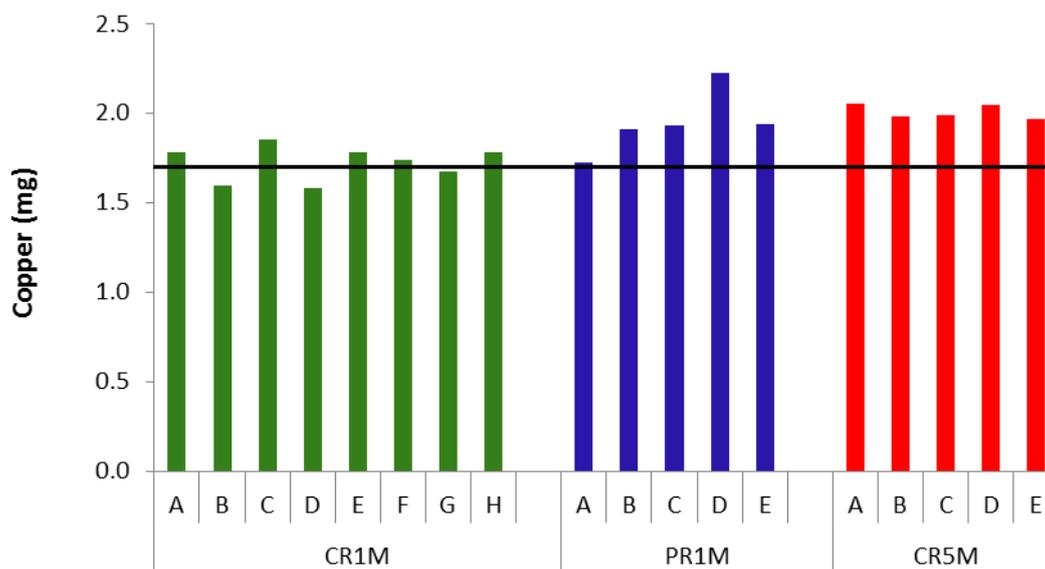


Figure 18 Copper content of 2012/13 CRP vs RNC

3.3.5 Iodine

CR1M and CR5M met the RNC for iodine (Figure 19). One menu of PR1M clearly met the requirement and one menu marginally (<5% below) met it. In Australia, dietary intake of iodine has declined over the past 50 years; since 2009 it has been mandatory to use iodised salt in bread-making (NHMRC, 2006; FSANZ, 2009). It is considered important for CRP to contain adequate amounts of iodine particularly as a soldier's normal diet may not compensate for low levels of iodine in CRP.

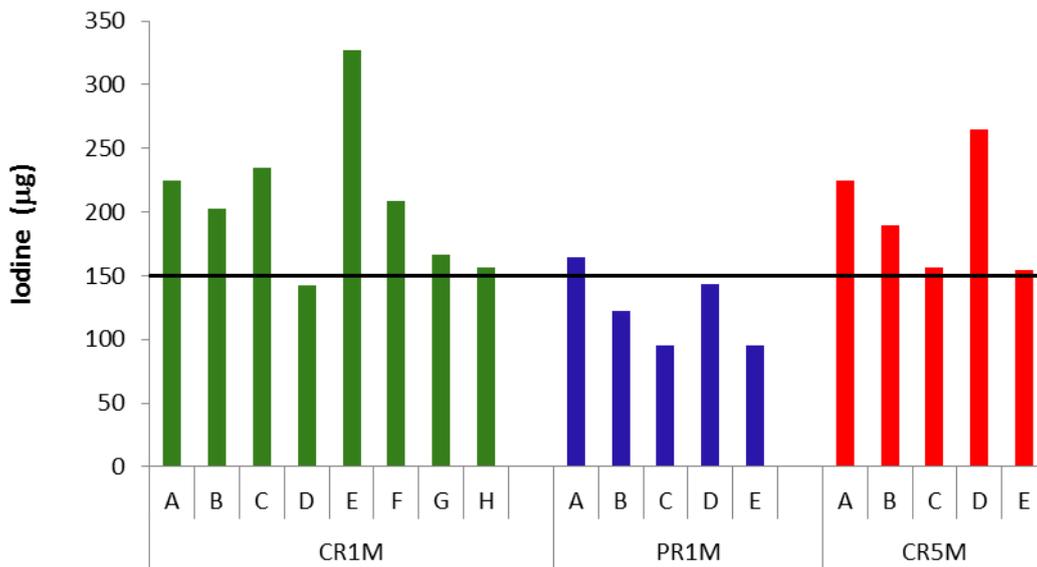


Figure 19 Iodine content of 2012/13 CRP vs RNC

3.3.6 Iron

CR1M was compliant with the RNC for iron, all menus being within -5% and +14% of the RNC (Figure 20). All menus of CR5M exceeded the RNC. PR1M failed, on average, to meet the RNC – although one menu was high in iron, two menus contained less than 60% of the requirement. The main sources of iron in CRP were main meals, chocolate drink powder, muesli mix and ration chocolate.

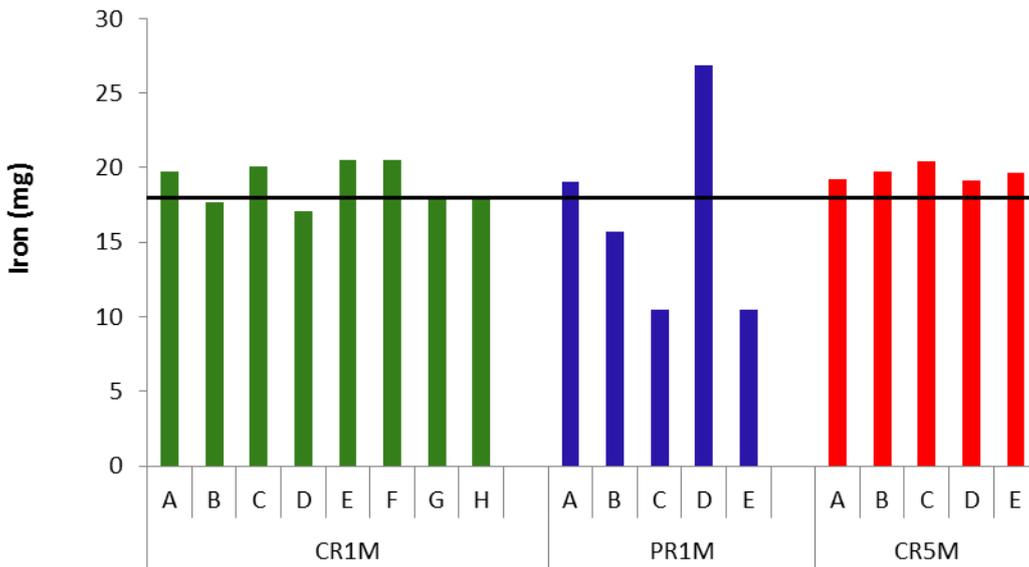


Figure 20 Iron content of 2012/13 CRP vs RNC

The MRDI for male soldiers is 8 mg/day, and all menus of CRP contain sufficient for this requirement to be met, however, the RNC was set at 18 mg to ensure adequate amounts would be present for female soldiers.

3.3.7 Magnesium

Five menus of CR1M met the RNC and the average across all CR1M menus marginally met it (Figure 21). Four menus of CR5M were marginal and one menu clearly met the RNC. Three menus of PR1M and the average value failed to meet the RNC. PR1M contained 20% less magnesium than CR1M and CR5M.

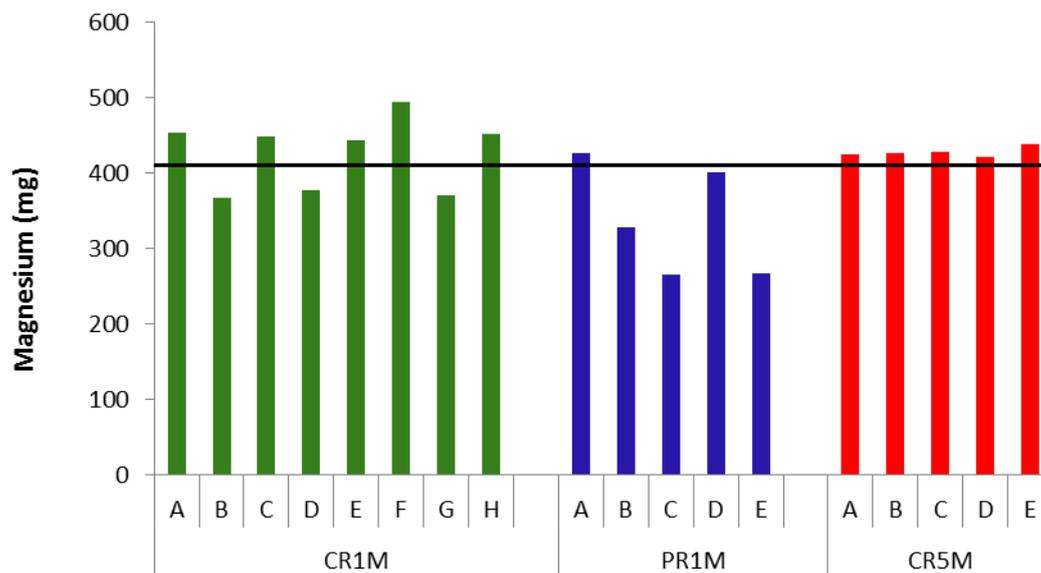


Figure 21 Magnesium content of 2012/13 CRP vs RNC

3.3.8 Manganese

CR1M, on average, met the RNC for manganese with five menus exceeding the requirement and three menus falling short (Figure 22). PR1M met the requirement overall despite two menus being very marginally below the RNC. All five CR5M menus failed to reach the RNC. The main sources of manganese were cereal-based products, main meals, chocolate-based products (chocolate drink powder, chocolate spread, chocolate candy, ration chocolate) and vegetables. Particularly important sources in CR1M were the muesli mixes present in all menus except B, D and G.

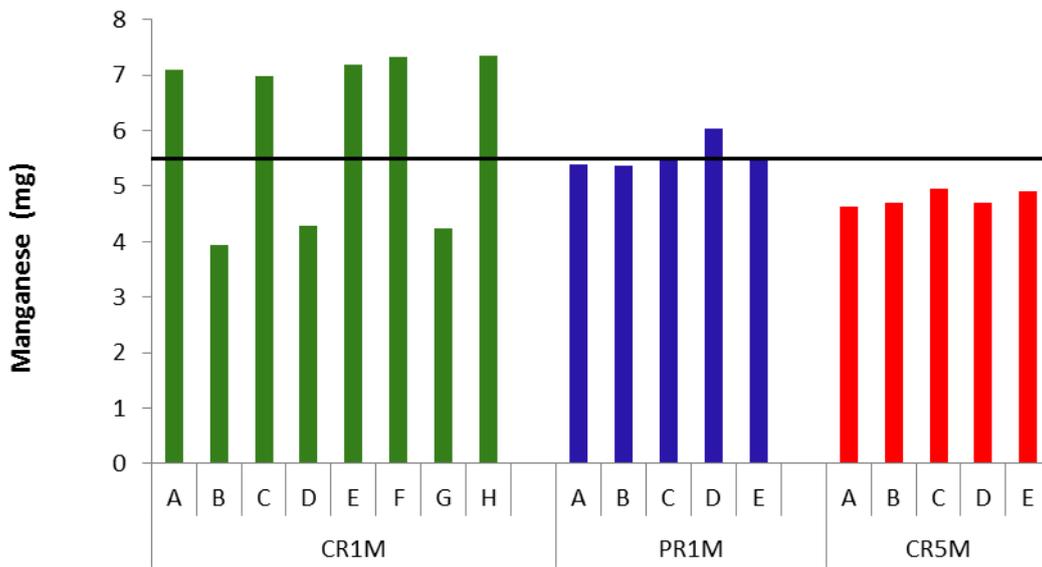


Figure 22 Manganese content of 2012/13 CRP vs RNC

3.3.9 Phosphorus

CR1M, PR1M and CR5M all met the RNC for phosphorus (Figure 23).

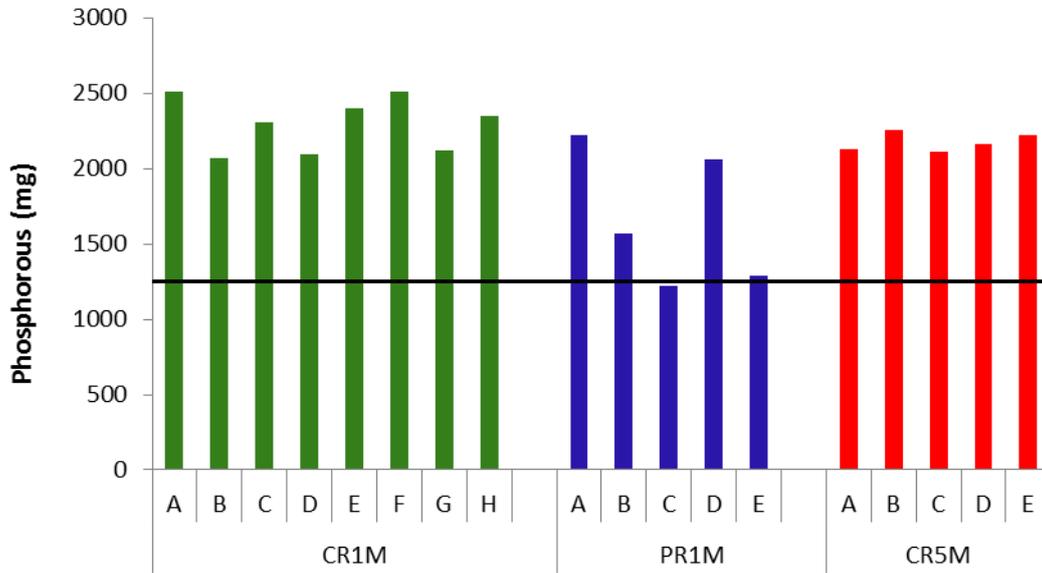


Figure 23 Phosphorous content of 2012/13 CRP vs RNC

3.3.10 Potassium

The RNC for potassium was met by all CR1M and CR5M menus (Figure 24). Two PR1M menus met the RNC and three failed to meet it. The main reason for the three failures was the lower potassium levels in the main meals in those menus.

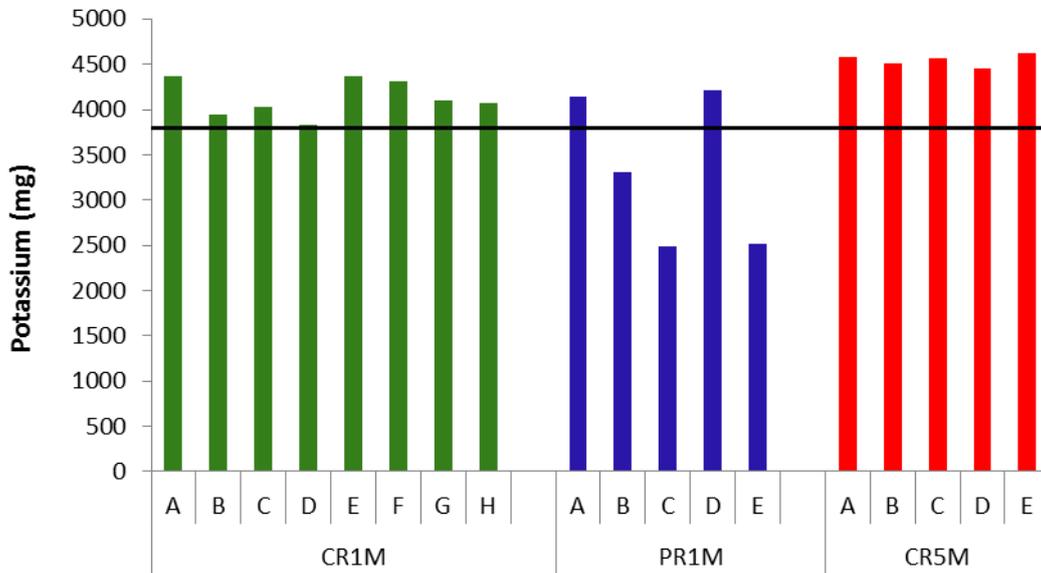


Figure 24 Potassium content of 2012/13 CRP vs RNC

3.3.11 Selenium

CR1M menus showed great variability ranging from twice the RNC (Figure 25) to about three-quarters of it. Four menus of PR1M were below the RNC and one above, while CR5M was split two above and three below the RNC. The value of seafood as a source of selenium is reflected in the fact that the CR1M menus with the highest levels of selenium are those containing tuna, and the PR1M menu with the highest level of selenium contains FD tuna mornay. Other useful sources include chicken-based main meals, processed cheese and some of the cereal-based products.

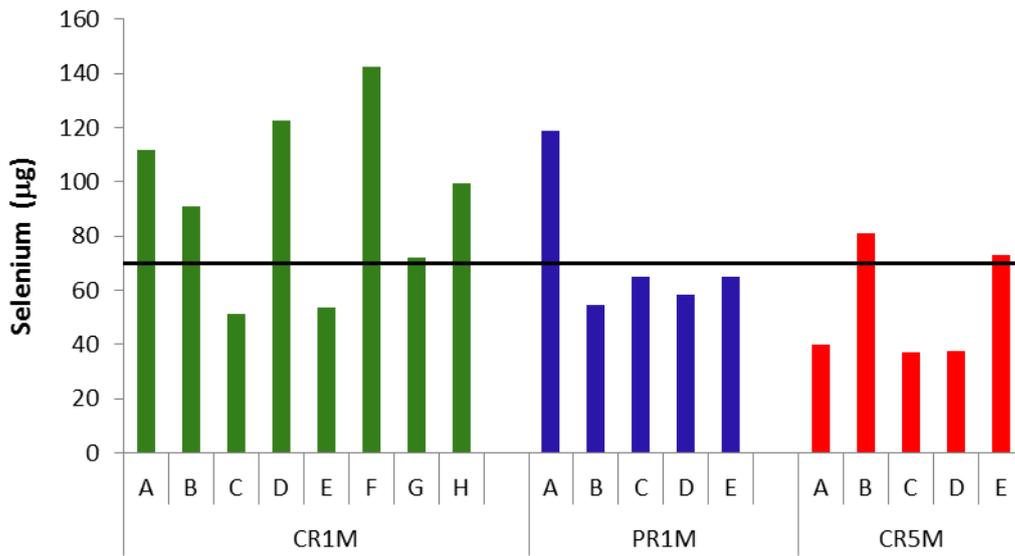


Figure 25 Selenium content of 2012/13 CRP vs RNC

3.3.12 Sodium

PR1M was within range for sodium, that is the mean level was between the upper and lower limits of the RNC (Figure 26). All menus of CR1M and CR5M exceeded the UL of the RNC. The menu with the highest level of sodium exceeded the upper RNC by 43%. The main sources of sodium were main meals, concentrated yeast extract, soup mixes, instant noodle flavouring and processed cheese.

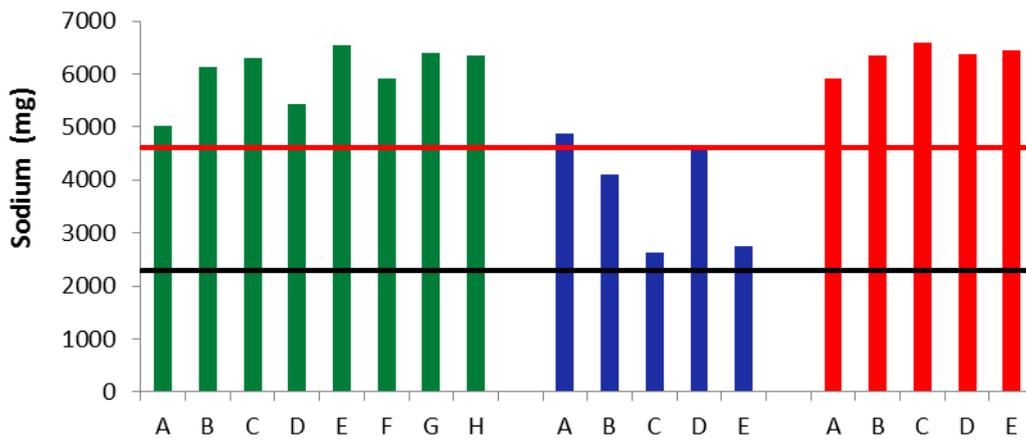


Figure 26 Sodium content of 2012/13 CRP vs RNC. The red line indicates the UL and the black line the LL of the RNC

3.3.13 Zinc

All menus of CR1M and CR5M met the RNC for zinc (Figure 27). Three menus of PR1M met the requirement and two menus failed due to levels of zinc that were less than half the RNC. Important sources of zinc were main meals, sweetened condensed milk, processed cheese, beef steak bar, muesli mix, ration chocolate and concentrated yeast extract.

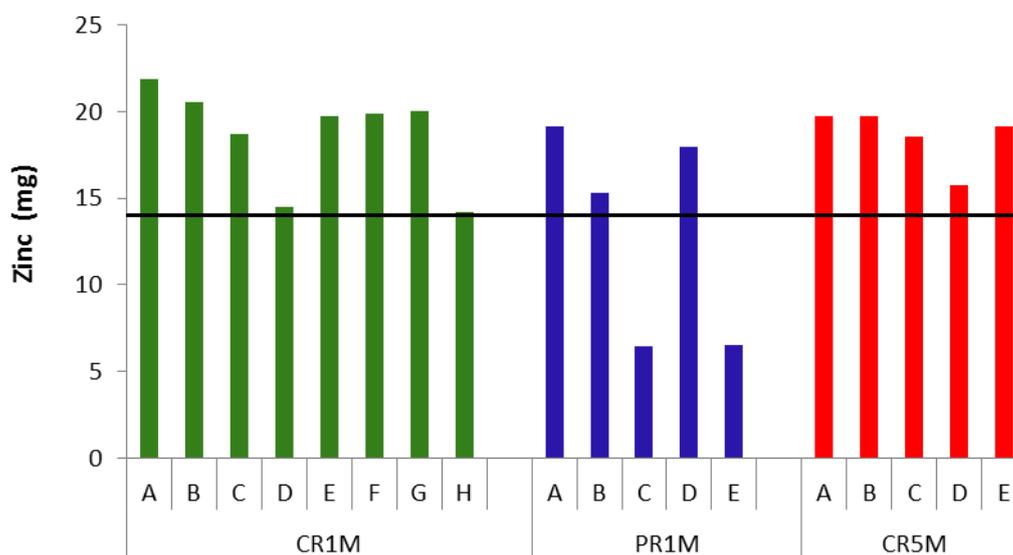


Figure 27 Zinc content of 2012/13 CRP vs RNC

4. Conclusions

The 2012/13 CRP generally met the RNC requirements for macronutrients and energy with the following being of note:

- The RNC for energy (16 MJ) was met by all CRP menus (range 17.5 to 19.7 MJ). Consideration may need to be given to the costs and benefits of such a generous margin
- CR1M and CR5M marginally met the protein requirement, whereas PR1M was marginally high
- On average, all three types of CRP were within the desired range for total fat, albeit marginally high for CR1M
- Saturated plus trans- fat was well above maximum recommended values for all CRP menus
- CHO was consistently high but well distributed across all CR1M, PR1M and CR5M menus
- The P:F:C ratio of 13-18:23-33:54-59 was not met by any of the CRP. PR1M performed best on this measure – the ratio was within range for protein and fat, and only marginally above the recommended level for CHO.

Owing to some fortification, compliance with the RNC for vitamins was better for CR1M and CR5M than for PR1M:

- The fortified CR1M and CR5M menus met the RNC for seven of the ten vitamins
- The unfortified PR1M met the RNC for only three of the ten vitamins. The lack of fortification of main meals is the key factor in the failure of PR1M to fully meet vitamin requirements.

All three types of CRP were non-compliant with the RNC for minerals:

- CR1M was compliant with most RNC, a notable failure being the high levels of sodium
- CR5M was non-compliant for calcium, sodium, manganese and selenium
- The least compliant type of CRP was PR1M, with non-compliances for 50% of the minerals that were evaluated: calcium, iodine, iron, magnesium, potassium and zinc
- Inclusion of calcium fortified chewing gum in approximately half the menus has resulted in CR1M, on average, meeting the RNC for calcium and significant improvement in the overall calcium status of CR5M and PR1M.

The nutrient profile of CR1M has improved relative to the 2008/09 procurement. Particular improvements were noted for protein, vitamin A, calcium and iron. The vitamin B₆, folate and vitamin K levels remain low and need to be improved. Vitamin E levels in CR1M and CR5M will fail to meet the RNC if the chocolate spread is removed and not replaced with an equivalent product.

PR1M failed to meet more requirements than CR1M and CR5M largely due to there being no fortification of its components. PR1M is used by Special Forces soldiers, yet does not comply with vitamin and mineral RNCs. This is of particular concern as Special Forces soldiers 'push the envelope' with respect to physical activity levels and endurance. For good cognitive and physical performance appropriate levels of nutrition, and particularly vitamins and minerals, are needed.

Common items contribute half the energy content of CR1M and PR1M and considerably more in the case of CR5M. The commonality, or repetition, of menu items should be as low as practicable to avoid menu boredom and under-consumption.

5. Recommendations

It is recommended that:

- DMO's continual improvement process for CRP remains in place as it has achieved demonstrable benefits
- A focus is placed on improving the PR1M through fortification with selected vitamins and minerals
- Chewing gum fortified with calcium is included in all CRP menus
- The level of commonality in CRP menus is reviewed with a view to reducing the likelihood of menu fatigue and under-consumption.

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Appendix A: Recommended Nutritional Criteria

Table A1 RNC for General Purpose Combat Ration Packs (Forbes-Ewan, 2009)

Nutritional	RNC*
Energy (MJ)	16
Protein (g)	122-150
Fat, total (g)	108-143
Saturated + <i>trans</i> fat (g)	≤ 43
CHO (g)	565-590
Dietary Fibre (g)	24
Vitamin A (µg)	900
Vitamin C (mg) [#]	135
Vitamin E (mg)	10
Thiamin (mg) [#]	5.1
Riboflavin (mg) [#]	7.5
Niacin (mg) [#]	78
Vitamin B ₆ (mg) [#]	7.5
Vitamin B ₁₂ (µg)	2.4
Folate (µg)	400
Pantothenic Acid (mg)	6
Biotin (mg)	30
Choline (mg)	550
Vitamin D (µg)	5
Vitamin K (µg)	70
Calcium (mg)	1300
Chromium (µg)	35
Copper (mg)	1.7
Iodine (µg)	150
Iron (mg)	18
Magnesium (mg)	410
Manganese (mg)	5.5
Molybdenum (µg)	45
Phosphorus (mg)	1250
Potassium (mg)	3800
Selenium (µg)	70
Sodium (mg)	2300-4600
Zinc (mg)	14

* Based on the experimental result that typical field exercises involve energy expenditures of 15-16 MJ per day for male ADF members (Category 3). All other values are based on the 'worst case' situation—i.e. the MRDI (or an appropriate percentage of the MRDI) for the population group with the greatest estimated requirement for that nutrient. These criteria are recommended to apply at the time of packing, not necessarily at the time of consumption. They do not necessarily apply to mission-specific ration packs.

The recommended levels of these vitamins are three times the MRDI for adult males at Category 3 physical workload, to allow for likely loss during storage and also for discarding of ration items.

Appendix B: CRP Menu Sheets

PACKED: 2012/ 2013

AUSTRALIAN DEFENCE FORCE – COMBAT RATIONS ONE MAN

MENU SHEET

FOOD ALLERGIES: This ration pack does **NOT** cater for consumers with any food allergy or special dietary requirements. You should read the **Menu, Information and Ingredients Sheets** before consumption. If you have any doubt about the contents, you should not consume the ration pack.

MENU A		MENU B		MENU C		MENU D	
Beef BBQ	1 x 250g	Braised Beef with Gravy	1 x 250g	Beef & Blackbean	1 x 250g	Beef & Pasta	1 x 250g
Lamb with Rosemary	1 x 250g	Chicken Pasta with Vegetables	1 x 250g	Curried Sausages & Vegetables	1 x 250g	Chicken BBQ	1 x 250g
Pea & Ham Soup	1 x 30g	Butternut Pumpkin & Ham Soup	1 x 30g	Pea & Ham Soup	1 x 30g	Butternut Pumpkin & Ham Soup	1 x 30g
Sports Drink Powder, Tropical	1 x 70g	Sports Drink Powder, Orange	1 x 70g	Sports Drink Powder, Lemon & Lime	1 x 70g	Sports Drink Powder, Mixed Berry	1 x 70g
Biscuit Jam Sandwich	1 x 48g	Biscuit, Plain Sweet	1 x 35g	Biscuit, Plain Sweet	1 x 35g	Biscuit Jam Sandwich	1 x 48g
Biscuit, Crispbread	1 x 34g	Biscuit, Cream Cracker	1 x 35g	Biscuit, Cream Cracker	1 x 35g	Biscuit, Crispbread	1 x 34g
Fruitcake Bar	1 x 75g	All Fruit Bar, Mixed Fruit	2 x 20g	Fruitcake Bar	1 x 75g	All Fruit Bar, Mixed Fruit	2 x 20g
Fruit Jam, Plum	1 x 26g	Fruit Jam strawberry	1 x 26g	Fruit Jam, Marmalade	1 x 26g	Fruit Jam, Strawberry	1 x 26g
Diced Two Fruits in Syrup	1 x 140g	Diced Two Fruits in Syrup	1 x 140g	Diced Peaches in Syrup	1 x 140g	Diced Pears in Syrup	1 x 140g
Cereal Bar various	1 x 50g	Cereal Bar various	2 x 50g	Cereal Bar various	1 x 50g	Cereal Bar various	2 x 50g
Muesli, Fruitful with Skim Milk	1 x 100g	Noodles, Instant, Curry Flavour	1 x 40g	Muesli, Natural with Skim Milk	1 x 100g	Tuna & French Dressing	1 x 85g
Tuna & Oven Dried Tomato	1 x 85g	Werther's® Cream Candy	1 x 50g	Noodles, Instant, Beef Flavour	1 x 40g	Werther's® Cream Candy	1 x 50g
Lifesavers® Candy	1 x 34g			Lifesavers® Candy	1 x 34g		

MENU E		MENU F		MENU G		MENU H	
Beef Minced Savoury with Vegetables	1 x 250g	Beef Teriyaki	1 x 250g	Braised Beef with Gravy	1 x 250g	Lamb with Vegetables & Rosemary	1 x 250g
Lamb Vindaloo	1 x 250g	Chilli Tuna & Pasta	1 x 250g	Chicken Italiano	1 x 250g	Sausages & Vegetables	1 x 250g
Pea & Ham Soup	1 x 30g	Butternut Pumpkin & Ham Soup	1 x 30g	Pea & Ham Soup	1 x 30g	Butternut Pumpkin & Ham Soup	1 x 30g
Sports Drink Powder, Grape	1 x 70g	Sports Drink Powder, Tropical	1 x 70g	Sports Drink Powder, Lemon & Lime	1 x 70g	Sports Drink Powder, Mixed Berry	1 x 70g
Biscuit Jam Sandwich	1 x 48g	Biscuit, Plain Sweet	1 x 35g	Biscuit, Plain Sweet	1 x 35g	Biscuit Jam Sandwich	1 x 48g
Biscuit, Cream Cracker	1 x 35g	Biscuit, Crispbread	1 x 34g	Biscuit, Cream Cracker	1 x 35g	Biscuit, Crispbread	1 x 34g
Fruitcake Bar	1 x 75g	All Fruit Bar, Raspberry	2 x 20g	Fruitcake Bar	1 x 75g	All Fruit Bar, Raspberry	2 x 20g
Fruit Jam, Plum	1 x 26g	Fruit Jam Strawberry	1 x 26g	Fruit Jam, Marmalade	1 x 26g	Fruit Jam Plum	1 x 26g
Diced Two Fruits in Syrup	1 x 140g	Diced Peaches in Syrup	1 x 140g	Diced Peaches in Syrup	1 x 140g	Diced Two Fruits in Syrup	1 x 140g
Cereal Bar various	1 x 50g	Cereal Bar various	1 x 50g	Cereal Bar various	2 x 50g	Muesli, Fruitful with Skim Milk	1 x 100g
Muesli, Fruitful with Skim Milk	1 x 100g	Muesli, Natural with Skim Milk	1 x 100g	Noodles, Instant, Curry Flavour	1 x 40g	Tuna & Oven Dried Tomato	1 x 85g
Noodles, Instant, Beef Flavour	1 x 40g	Tuna & Lime / Black Pepper	1 x 85g	Lifesavers® Candy	1 x 34g	Noodles, Instant, Curry Flavour	1 x 40g
Lifesavers® Candy	1 x 34g	Werther's® Cream Candy	1 x 50g			Werther's® Cream Candy	1 x 50g

ADDITIONAL ITEMS COMMON TO ALL MENUS

Chocolate Drink	1 x 40g	Concentrated Yeast Extract	1 x 15g	Beef Steak Bar	1 x 25g	Pads, Scouring, Soaped	1
Instant Coffee	2 x 3.5g	Tomato Ketchup	1 x 15g	Rubber Band, Size 32	3	Paper, Toilet, 10 Sheets	1
Tea Bags	2 x 2.5g	Pepper, Black	1 x 2g	Bag, Plastic, Self Closure	1	Menu Sheet	1
Sugar, White	4 x 7g	Salt	1 x 2g	Opener, Can, Hand	1	Ingredient Sheet	1
Chocolate Ration	2 x 50g	Sweetened Condensed Milk	1 x 85g	Matches, Safety, Vial	1	Information Sheet	1
Candy Chocolate	1 x 55g	Chewing Gum, Sugar free	2 x Pkts	Bag, Plastic, Inner	1		
Processed Cheddar Cheese	1 x 56g	Chocolate Spread (Nut Free)	1 x 50g	Spoon Plastic	1		

**AUSTRALIAN DEFENCE FORCE – PATROL RATION ONE MAN
MENU SHEET**

FOOD ALLERGIES: This ration pack does **NOT** cater for consumers with any food allergy or special dietary requirements. You should read the **Menu, Information and Ingredients Sheets** before consumption. If you have any doubts about the contents, you should not consume the ration pack.

Menu A					
Freeze Dried Tuna Mornay	1 x 110g	Freeze Dried Beef Teriyaki	1 x 110g	All Fruit Bar, Mixed Fruit	2 x 20g
Beverage Powder, Mixed Berry	1 x 70g	Fruit Jam Plum	1 x 26g	Cereal Bar various	1 x 50g
Noodles, Instant, Beef Flavour	1 x 40g	Biscuit, Plain Sweet	1 x 35g		
Cereal Bar various	1 x 50g	Lifesavers® Candy	1 x 34g		

Menu B					
Freeze Dried Beef & Noodles	1 x 110 g	Freeze Dried Savoury Beef	1 x 110 g	All Fruit Bar, Raspberry	2 x 20g
Beverage Powder, Tropical	1 x 70 g	Fruit Jam, Marmalade	1 x 26 g	Cereal Bar various	1 x 50g
Noodles, Instant, Curry Flavour	1 x 40g	Biscuit, Plain Sweet	1 x 35g		
Cereal Bar various	1 x 50g	Werther's® Cream Candy	1 x 50g		

Menu C					
Freeze Dried Beef & Blackbean	1 x 110g	Freeze Dried Veal Italienne	1 x 110g	All Fruit Bar, Mixed Fruit	2 x 20g
Beverage, Powder, Lemon & Lime	1 x 70g	Fruit Jam, Strawberry	1 x 26g	Cereal Bar various	1 x 50g
Noodles, Instant, Beef Flavour	1 x 40g	Biscuit Jam Sandwich	1 x 48g		
Cereal Bar various	1 x 50g	Lifesavers® Candy	1 x 34g		

Menu D					
Freeze Dried Lamb Casserole	1 x 110g	Freeze Dried Spaghetti & Meat Sauce	1 x 110g	All Fruit Bar, Raspberry	2 x 20g
Beverage, Powder, Orange	1 x 70g	Fruit Jam, Plum	1 x 26g	Cereal Bar various	1 x 50g
Noodles, Instant, Curry Flavour	1 x 40g	Biscuit, Plain Sweet	1 x 35g		
Cereal Bar various	1 x 50g	Werther's® Cream Candy	1 x 50g		

Menu E					
Freeze Dried Beef & Green Beans	1 x 110g	Freeze Dried Veal Italienne	1 x 110g	All Fruit Bar, Mixed Fruit	2 x 20g
Beverage, Powder, Grape	1 x 70g	Fruit Marmalade	1 x 26g	Cereal Bar various	1 x 50g
Noodles, Instant, Beef Flavour	1 x 40g	Biscuit Jam Sandwich	1 x 48g		
Cereal Bar various	1 x 50g	Lifesavers® Candy	1 x 34g		

Additional Food Items Common to all PR1M Menus					
Beverage, Chocolate, Powder	1 x 40g	Tomato Ketchup	1 x 15g		
Biscuit, Crispbread	1 x 34g	Sweetened Condensed Milk	1 x 85g		
Pepper, Black	1 x 2g	Tea Bags	2 x 2.5g		
Freeze Dried Rice	1 x 55g	Chocolate Ration	2 x 50g		
Chewing Gum, Sugar free	2 x pkt	Candy, Chocolate	1 x 55g		
Instant Coffee	2 x 3.5g	Sugar, White	6 x 7g		
Salt	1 x 2g	Concentrated Yeast Extract	1 x 15g		

Non-Food Items Common to all PR1M Menus					
Matches, Safety, Vial	1	Menu Sheet – Components, PR1M	1	Bag Plastic Self Closure	1
Bag, Plastic, Inner	1	Information Sheet	1	Paper, Toilet, 10 Sheet	1 pkt
Rubber Bands Size 32	2	Ingredients Sheet	1	Pad, Scouring, Soaped	1
Spoon Plastic	1				

AUSTRALIAN DEFENCE FORCE COMBAT RATION FIVE MAN

PACKED: 2012/ 2013

MENU SHEET

FOOD ALLERGIES: This ration pack does **NOT** cater for consumers with any food allergy or special dietary requirements. You should read the **Menu, Information and Ingredients Sheets** before consumption. If you have any doubts about the contents, you should not consume the ration pack.

A		B		C		D		E	
Beef & Blackbean	2 x 500g	Braised Beef with Gravy	2 x 500g	Beef & Pasta	2 x 500g	Beef Minced Savoury with Veg	2 x 500g	Beef, Braised with Gravy	2 x 500g
Lamb with Rosemary	2 x 500g	Chicken Pasta & Vegetables	2 x 500g	Lamb Vindaloo	2 x 500g	Lamb w/Veg & Rosemary	2 x 500g	Chilli Tuna & Pasta	2 x 500g
Bev Powder, Tropical	5 x 70g	Bev Powder, Lemon & Lime	5 x 70g	Beverage Powder, Grape	5 x 70g	Bev Powder, Mixed Berry	5 x 70g	Bev Powder, Orange	5 x 70g
Biscuit, Plain Sweet	5 x 35g	Biscuit, Plain Sweet	5 x 35g	Biscuit Jam Sandwich	5 x 48g	Biscuit - Plain, Sweet	5 x 35g	Biscuit Jam Sandwich	5 x 48g
Diced Two Fruits in Syrup	5 x 140g	Diced Peaches in Syrup	5 x 140g	Diced Two Fruits in Syrup	5 x 140g	Diced Pears in Syrup	5 x 140g	Diced Peaches in Syrup	5 x 140g
Fruit Jam - Plum	5 x 26g	Fruit Jam - Strawberry	5 x 26g	Fruit Marmalade	5 x 26g	Fruit Jam -Plum	5 x 26g	Fruit Jam- Strawberry	5 x 26g
Pudding, Plum	1 x 350g	Pudding, Chocolate	1 x 300g	Pudding, Plum	1 x 350g	Pudding, Chocolate	1 x 300g	Pudding, Plum	1 x 350g
Pea & Ham Soup	5 x 30g	Butternut Pumpkin & Ham Soup	5 x 30g	Pea & Ham Soup	5 x 30g	Butternut Pumpkin & Ham Soup	5 x 30g	Pea & Ham Soup	5 x 30g
Cereal Bar various	5 x 50g	Cereal Bar various	5 x 50g	Cereal Bar various	5 x 50g	Cereal Bar various	5 x 50g	Cereal Bar various	5 x 50g
Additional items common to all CR5M menus									
Chocolate Drink	5 x 40g	Salt	5 x 2g	Potatoes, Cubed	2 x 500g	Container, Sundry, Plastic	4	Rubber Bands Size 32	3
Instant Coffee	10 x 3.5g	Pepper, Black	5 x 2g	Peas, Green	1 x 250g	Matches, Safety, Vial	2		
Tea Bags	10 x 2.5g	Tabasco sauce	5 x 3.5g	Carrots, Sliced	1 x 250g	Pads, Scouring, Soaped	2		
Sugar, White	30 x 7g	Tomato Ketchup	3 x 15g	Corn, Sweet, whole kernel	1 x 250g	Toilet Paper, 10 Sheets	5 Pkt		
Sweet Condensed Milk	5 x 85g	Biscuit Crispbread	5 x 34g	Choc Spread (Nut Free)	5 x 50g	Information Sheet	1		
Cheddar Cheese	5 x 56g	Yeast Extract	5 x 15g	Beef Steak Bar	5 x 25g	Ingredient Sheet	1		
Chocolate Ration	10 x 50g	Baked Beans	2 x 500g	Chewing Gum, Sugar free	5 x pkt	Menu Sheet	1		
Candy Chocolate	5 x 55g	Rice	1 x 330g	Can Opener	2	Spoon Plastic	5		

Appendix C: CRP Menu Summaries

Table C1 Summary of 2012/2013 CRP – main menu items

Items per menu	Menus*		
	CR1M	PR1M	CR5M
Menu	8 (A to H)	5 (A to E)	5 (A to E)
Main meal	Retort pouches (2x250 g)	Freeze dried meals 2x110 g	Retort pouches (4x500 g)
Beverage drink powder	1x70 g	1x70 g	5x70 g
Biscuits	a. 1x48 g & 1x34 g or b. 2x35 g	a. 1x35 g or b. 1x48 g	a. 5x35 g or b. 5x48 g
Soup	1x30 g	—	5x30 g
Noodle/Tuna	a. Noodles (1x40 g)/Tuna (1x85 g) b. Noodles (1x40 g) & Tuna (1x85 g), Menu H.	Noodles (1x40 g)	—
Cereal	a. Cereal bar (1x50 g) & Muesli mix (1x100 g) or b. Cereal bars (2x50 g) or c. Muesli mix (1x100 g)	Cereal bars (2x50 g)	Cereal bars (5x50 g)
Fruit cake/bar	a. Fruit cake bar 1x75 g or b. All fruit bar 2x20 g	2x20 g	a. Pudding (1x350 g) or b. Pudding (1x300 g)
Fruit jam	1x26 g	1x26 g	5x26 g
Fruit (canned)	1x140 g	—	5x140 g
Candy	a. 1x34 g or b. 1x50 g	—	—
Total of items	12 (B, D, G) 13 (A, C, E, F, H)	10	35

*a. and b. annotations indicate that products are not available in all menus

Table C2 Summary of 2012/2013 CRP – common items

Items	Additional items common to all menus for each CRP type		
	CR1M	PR1M	CR5M
Most of the additional items are included in each Menu of CRs are the same (drink powders, confectionery, dairy products, yeast extract, and condiments); except:			
Chocolate drink	1x40 g	1x40 g	5x40 g
Instant coffee	2x3.5 g	2x3.5 g	10x3.5 g
Tea bag	2x2.5 g	2x3.5 g	10x3.5 g
Sugar, white	4x7 g	6x7 g	30x7 g
Chocolate ration	2x50 g	2x50 g	10x50 g
Candy chocolate	1x55 g	1x55 g	5x55 g
Yeast extract	1x15 g	1x15 g	5x15 g
Salt	1x2 g	1x2 g	5x2 g
Pepper	1x2 g	1x2 g	5x2 g
Chewing gum	2xpkts	2x6 g	10x6 g
Sweeten condensed milk	1x85 g	1x85 g	5x85 g
Cheese, Cheddar	1x56 g	—	5x56 g
Chocolate Spread	1x50 g	—	5 x50 g
Beef steak bar	1x25 g	—	5 x50 g
Biscuit, Crispbread	Included in the main Menus	1	5x34 g
Rice	—	1 (FD)	1 x330 g (retort pouch)
Baked Beans	Included in the main Menus	—	2 x 500 g
Vegetables	Included in the main Menus	—	
Potatoes, cubed;			2 x 500 g
Peas, green;			1 x 250 g
Carrots, Sliced;			1 x 250 g
Corn, Sweet, Whole Kernel			1x 250 g
Sauce, Sweet, Chilli	—	1	—
Curry powder	—	—	5x35 g
Tomato ketchup	—	—	3x15 g

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19. ABSTRACT DSTO has evaluated the nutrient content of 2012/13 Combat Ration One Man (CR1M), Patrol Ration One Man (PR1M) and Combat Ration Five Man (CR5M) against the Recommended Nutritional Criteria (RNC) for Combat Ration Packs (CRP). RNC ensure that soldiers are provided with their daily nutrient requirements when rationed on CRP. The evaluation was based primarily on analytical testing of samples of CRP components. The macronutrient and energy requirements generally met requirements. Compliance with the RNC for vitamins and minerals was better for CR1M and CR5M than for PR1M. The positive results for the 2012/13 CR1M in comparison to the 2008/09 CR1M, indicates that efforts to improve CRP have been effective.					